MICROCOMPUTING FOR HOME AND SMALL BUSINESS

VOL. 2, ISSUE 4, MARCH, 1977

\$1.50

C. Lester Hogan Reflects on Semiconductor Technology

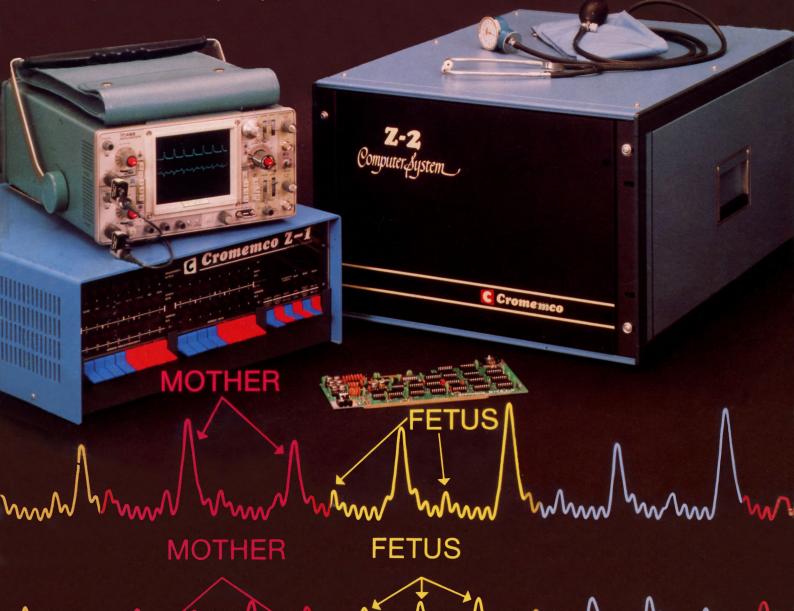
A Computer Even a Baby Can Use

The Menace of the Microworld

The Qube

Graphics, the Easy Way

SPECIAL COMPUTER FAIRE HARDWARE/SOFTWARE GUIDE EDITION



Old Fashion WALUE

in the



Tradition

Our 6800 computer system represents the best value available today, with no sacrifice in performance.

I would like to explain why this is true. The most basic reason is that the 6800 is a simpler, more elegant machine. The 6800 architecture is memory oriented rather than bus oriented as are the older 8008, 8080 and Z-80 type processors. This is an important difference. It results in a computer that is far easier to program on the more basic machine language and assembly language levels. It also results in a far simpler bus structure. The 6800 uses the SS-50 bus which has only half the connections needed in the old S-100 (IMSAI/MITS) bus system. If you don't think this makes a difference, take a look at the mother boards used in both systems-compare them. The SS-50 system has wide, low impedance 0.1 lines with good heavy, easily replaced Molex connectors. The S-100 bus, on the other hand, has a very fine hair-like lines that must be small enough to pass between pins on a 100 contact edge connector. I'll give you one guess which is the most reliable and noise free. As for cost-well any of

you who have purchased extra connectors for your S-100 machines know what kind of money this can run into. The 6800 is supplied with all mother board connectors. No extras, or options like memory, or connectors for the mother board are needed in our 6800 system.

The 6800 is not beautiful, but "Oh Boy" is it functional. That plain black box is strong and it has an annodized finish. This is the hardest, toughest finish you can put on aluminum. Most others use paint, or other less expensive finishes. The 6800 does not have a pretty front panel with lights and multicolor switches. This is because the lights and switches are not only expensive, and unnecessary, but also a great big pain to use. We don't crank up the 6800; we use an electric starter-a monitor ROM called Mikbug. He automatically does all the loading for you without any time wasting switch flopping. So in the 6800 system you don't buy something expensive (the console) that you will probably want to stop using as soon as you can get your hands on a PROM board and a good monitor.

That's another thing. Mikbug® is a standard Motorola part. It is used in many systems and supported by the Motorola software library in addition to our own extensive collection of programs. It is not an orphan like many monitor systems that are unique to the manufacturer using them and which can only run software provided by that manufacturer. Check the program articles in Byte. Interface and Kilobaud. You will find that almost all 6800 programs are written for systems using a Mikbug[®] monitor. Guess how useful these are if you have some off-brand monitor in your computer.

The 6800 will never win any beauty prizes. It is like the Model "T" and the DC-3 not pretty, but beautiful in function. It is simple, easy to use and maintain and does its job in the most reliable and economical way possible. What more could you want?

Mikbug $^{\textcircled{8}}$ is a registered trademark of Motorola Inc.



Computer System

with serial interface and 4,096 words of memory \$395.00



SwTPC Computer Kit	Send Data
#	
Ex Date	
STATE	ZIP
	#Ex Date

Meet the most powerful μC system available for dedicated work. **Yet it's only \$595**.*

Here's the muscle you've been telling us you wanted: a powerful Cromemco microcomputer in a style and price range ideal for your dedicated computer jobs-ideal for industrial, business, instrumentation and similar applica-

It's the new Cromemco Z-2 Computer System. Here's some of what you get in the Z-2 for only \$595:

- The industry's fastest µP board (Cromemco's highly regarded 4 MHz, 250-nanosecond cycle time board).
- The power and convenience of the well-known Z-80
- A power supply you won't believe (+8V @ 30A, +18V and -18V @ 15A ample power for additional peripherals such as floppy disk drives).
- A full-length shielded motherboard with 21 card slots.
- Power-on-jump circuitry to begin automatic program execution when power is turned on.
- S-100 bus.
- Standard rack-mount style construction.
- All-metal chassis and dust case.
- 110- or 220-volt operation.

DEDICATED APPLICATIONS

The new Z-2 is specifically designed as a powerful but economical dedicated computer for systems work. Notice that the front panel is entirely free of controls or switches of any kind. That makes the Z-2 virtually tamper-proof. No accidental

program changes or surprise mem-

ory erasures.

FASTEST, MOST POWERFUL AC

Cromemco's microcomputers are the fastest and most powerful available. They use the Z-80 microprocessor which is

> Shown with optional bench cabinet

*kit price

widely regarded as the standard of the future. So you're in the technical fore with the Z-2.

BROAD SOFTWARE/PERIPHERALS SUPPORT

Since the Z-2 uses the Z-80, your present 8080 software can be used with the Z-2. Also, Cromemco offers broad software support including a monitor, assembler, and a BASIC interpreter.

The Z-2 uses the S-100 bus which is supported by the peripherals of dozens of manufacturers. Naturally, all Cromemco peripherals such as our 7-channel A/D and D/A converter, our well-known BYTESAVER with its built-in PROM programmer, our color graphics interface, etc., will also plug into the S-100 bus.

LOW, LOW PRICE

You'll be impressed with the Z-2's low price, technical excellence and quality. So see it right away at your computer store—or order directly from the factory.

- Z-2 COMPUTER SYSTEM KIT (MODEL Z-2K) (includes 4 MHz μP card, full-length 21-card-slot motherboard, power supply, one card socket and card-guide set, and front panel; for rack mounting)\$595.
- Z-2 COMPUTER SYSTEM ASSEMBLED (MODEL Z-2W) (includes the above as well as all 21 sockets and card guides and a cooling fan; for rack mounting)...\$995.





incorporate d Specialists in computers and peripherals

2432 CHARLESTON RD., MOUNTAIN VIEW, CA 94043 • (415) 964-7400

CIRCLE INQUIRY NO. 2

INTERFAL

MICROCOMPUTING FOR HOME AND THE SMALL BUSINESSMAN

SPECIAL COMPUTER FAIRE HARDWARE/SOFTWARE **GUIDE EDITION**

FEATURES

THE MENACE OF THE MICRO WORL ANOTHER LOOK AT THE WORLD OF ARTIFICIAL INTELLIGENCE	_D15 By Ken Berkun
REFLECTIONS ON THE PAST AND T THE FUTURE OF SEMICONDUCTOR IN THIS EXCLUSIVE ARTICLE DR. HOGAN SHARES HIS EXPERIENCE AND INSIGHT INTO THE HISTORY AND FUTURE OF THE INDUSTRY	TECHNOLOGY24
THE COMPUTER EVEN A BABY CAN AN EXAMPLE OF HOW THE MICRO- PROCESSOR IS USED AS A VALUABLE MEDICAL TOOL	USE
NEW PRODUCT GUIDE	47
THE QUBE	
A WHISPER FROM "THE INVENTOR'S CORNER"	By Roger Garrett
CARD OF THE MONTH—THE CROM AN IN-DEPTH EVALUATION OF A "FUN" CARD FOR T.V. ANIMATION	EMCO T.V. DAZZLER TM 104 By Roger Edelson
HARDWARE REPORT A POTPOURRI OF IC CHIPS FOR THE HOME COMPUTERIST	By Roger Edelson

DEPARTMENTS

Advertising Index	144
Book Review	100
Cover Story	2
FIFO Flea Market	142
From the Fountainhead	. 10
Hardware Report	110
Interfacial	4
Letters to the Editor	140
Micro-Market	141
New Products	. 47
Update	6

Cover Story

This month's cover highlights the new biomedical applications of microprocessors. Physician and programmer are now sharing a new partnership as the RAM takes its place beside the stethoscope. This application was developed in the Electrical Engineering Department of Stanford University. Cover credit goes to Cromemco who supplied the equipment for the project.

THE R SHALL	E 1514 A3 54	C Brist - Spool-	Ben A.S. E	2 2 Sec 3	con This
San San S	I AA W.L	S Super - St	Robert P. S. S.	W-0 1 5 2	hoo flow

SOFTWARE EDITORIAL	
OCTAL DEBUGGING PROGRAM (OD	T-80) PART IV LLL BASIC121 By E. R. Fisher
AMI'S RE-ENTRANT SELF-RELATIVE	SUBROUTINE (RS³)125 By Robert Stevens
GRAPHICS—THE EASY WAY	
Z-80 MITS 12K EXTENDED BASIC PAT	TCHES

INTERFACE AGE Magazine, published monthly by McPheters, Wolfe & Jones, 13913 Artesia Blvd., Cerritos, Calif. 90701. Subscription rates: U.S. \$10.00, Canada/Mexico \$12.00, all other countries \$18.00. Opinions expressed in by-lined articles do not necessarily reflect the opinion of this magazine or the

Canada/Mexico \$12.00, all other countries \$18.00. Opinions expressed in by-lined articles do not necessarily reflect the opinion of this magazine of the publisher. Mention of products by trade name in editorial material or advertisements contained herein in no way constitutes an endorsement of the product or products by this magazine or the publisher.

INTERFACE AGE Magazine COPYRIGHT © March 1977 by McPheters, Wolfe & Jones, ALL RIGHTS RESERVED. Material in this publication may not be reproduced in any form without permission. Requests for permission should be directed to Nancy Jones, Rights and Permissions, McPheters, Wolfe & Jones, 13913 Artesia Blvd., Cerritos, Calif. 90701.

POSTMASTER: Please send change of address form 3579 and undelivered copies to INTERFACE AGE Magazine, 13913 Artesia Blvd., Cerritos, Calif. 90701. Second-class postage paid at Artesia, California 90701 and at additional mailing offices.

2 INTERFACE AGE

The Digital Group adds character(s).



64, to be exact.

The Digital Group's computer systems have a lot of character already. Just one quick look at any of our products in their unique custom cabinets confirms that. But we believe it never hurts to add a bit more.

So, the Digital Group has added character in a big way to give an added dimension to the operation of our video-based computer systems. We are pleased

puter systems. We are pleased to announce our new TV readout with a 64-character line. It will give your system a great deal more capability. Give it more character, if you will.

Here are the specifics on the Digital Group TV Readout and Audio Cassette Interface:

1024 Character TV Readout

- 64 characters horizontal by 16 lines
- 7x9 character matrix (effectively 7x12 due to character shifting)
- 1K on-board RAM for buffer storage—requires no main memory—completely independent
- 128 character ASCII

Upper case alpha

Lower case alpha with base line extenders (g, j, p, y)

Numbers and extended math symbols

Greek alphabet

- · Software driven cursor-forward and backward
- Compatible with most microprocessors; Interfaces with 1 8-bit parallel output port
- Timebase may be driven with an external timebase (may be synchronized to TV camera, TV set, etc.)
- Readout timebase available at connector (can be used for graphic driver, etc.)
- White characters on black, and/or black on white; software selectable
- Plugs into standard dual 22-pin TVC connector on Digital Group Systems

Improved Audio Cassette Interface:

- Reliable FSK recording technique
- · Uses standard unmodified audio cassette recorder

- Write cassette system uses a digitally synthesized frequency shift system, derived from TV system's master crystal oscillator
- Read cassette system easily aligned using the write system as an alignment aid.
- · Runs at 1100 baud

(100 characters/second)—loads 16K in 3 minutes

512 TVC to 1024 TVC Upgrade Kit:

As always, when the Digital Group extends the capabilities of our systems, it doesn't mean obsolescence for any products. We are offering an upgrade kit for present Digital Group system owners who wish to go to the longer line length. This kit uses most of the IC's from our TVC-F readout. No unsoldering is required; all new sockets, capacitors, resistors, PC board and other necessary parts are supplied.

Prices:

TVC-64—Full 64-character TV Readout & Audio Cassette Interface:

Kit — \$140 Assembled — \$205

TVC-64UPG—Upgrade kit from TVC-F:

Kit — \$65

If you already own a Digital Group system, our 64-character line will definitely enhance its operation. If you're just looking, you might want to keep in mind that the Digital Group has a lot of characters.

Write or call now for details on our new 64-character TV readout and all our other exciting products.



box 6528 denver, colorado 80206 (303) 777-7133

CIRCLE INQUIRY NO. 3

IPMERFACIAL



This month INTERFACE AGE continues in its introduction of its staff to the readers. In this issue we are featuring two of the most important links in the long chain which begins with an author rolling a blank page into his typewriter through a finished article submitted and accepted on further to the published copy of the issue resting in the reader's hand.

Our two staff members presented this month are our Art Director and our Layout Editor.



Charlyne Levandowski has long experience as a freelance technical illustrator for areospace companies located in both East and West Coasts. Charlyne's contribution to INTERFACE AGE is well-known to our readers who have enjoyed her crisp clear artwork, accompanying every article recently published in this book.



Michael Antich is a Journalism graduate from California State University Long Beach where he also studied Graphic Arts. Former editor of the University Bulletin, he gained experience in all aspects of production. In his Senior year he worked as Art Director for the prestigious campus literary magazine

BLASTULI while contributing to the University Review and the student newspaper, The Forty-Niner.

This month's issue presents articles on the state of the art of microprocessing as viewed through the lens of the past, the eyes of the present and the crystal of the future.

Even by those whose involvement in electronics circumscribes a channel hunt on their T.V. sets, the Semiconductor Revolution has left its impact. Dr. C. Lester Hogan is one of the very human elements of this beneficent revolution. He has earned the title of "Father of Semiconductor Technology." In REFLECTIONS ON THE PAST AND THOUGHTS ABOUT THE **FUTURE OF SEMICONDUCTOR** TECHNOLOGY, Dr. Hogan relates the engrossing travelogue of the long journey from vacuum tube to chip.

In A COMPUTER THAT EVEN A BABY CAN USE the authors explain how a microprocessor is applied as a useful tool for the care of the unborn.

Reaching beyond today's technical capabilities we share Roger Garrett's dream of tomorrow's solid-state technology in THE QUBE.

Our readers will once again be entertained with another experiment in artificial intelligence. These learning programs are embryos of the robotic systems with which we'll live by the turn of the Century. And, in many ways these playmates are available to us now, as we see in Roger Edelson's evaluation of THE DAZZLERTM

The conscientious work of Bob Stevens has once more yielded a software section compiled to provide you with hours of enjoyment with your microcomputer.

INTERFACE AGE

13913 Artesia Boulevard Cerritos, CA 90701 (213) 926-6629

PUBLISHER & EDITOR-IN-CHIEF ROBERT S. JONES

ASSISTANT EDITOR
LINDA FOLKARD-STENGEL

GENERAL MANAGER NANCY A. JONES

ASSISTANT MANAGER EVA YAKA

NORTHWESTERN REGIONAL EDITOR ADAM OSBORNE PhD

NEW ENGLAND REGIONAL EDITOR ROBERT E. TRIPP

EDITORIAL CO-ORDINATOR WILLIAM SEVEDGE

> HARDWARE EDITOR ROGER EDELSON

SOFTWARE EDITOR ROBERT STEVENS

ASSOCIATE EDITOR
JANE HILL ALDEN

PRODUCTION LAYOUT
MIKE ANTICH

ART
CHARLYNE LEVANDOWSKI

SUBSCRIPTION CIRCULATION JO ANN FERGUSON

NATIONAL SALES MANAGER BRUCE BERKEY

ADVERTISING—Representative STEVE RICHARDS ZACH BOVINETTE

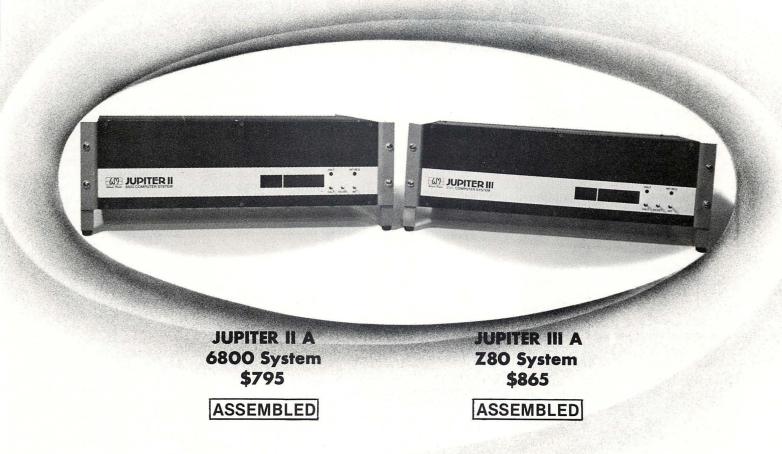
> RETAIL CIRCULATION ZACH BOVINETTE

Editorial Correspondence

Direct all correspondence to the appropriate editor at: INTERFACE AGE magazine, P.O. Box 1234, Cerritos, CA 90701. Editorial contributions must be accompanied by return postage and will be handled with reasonable care, however, publisher assumes no responsibility for return or safety of manuscripts, art work, or models.

Advertising Inquiries
Direct all advertising inquiries to:
Advertising Department, INTER-FACE AGE magazine, 61 South
Lake Avenue, P.O. Box 4566,
Pasadena, CA 91106. (213) 795-7002

POPULARITY EXPLOSION!



If you thought the quality of a wire-wrapped system was beyond your price range — Take a look at what we have now!

The Jupiter IIA and the Jupiter IIIA Basic computer systems. You get the system module cage with fully assembled backplane, fully assembled plug-in ferro-resonant power supply, front panel and your choice of 6800 or Z80 CPU module. All less than the price of the two best selling 8080 systems!

Plus you can choose from the fastest growing selection of memories and peripherals available from any manufacturer, like our 2KB EPROM/4KB RAM/serial RS-232 module and our new 1024 character video module. Both can transform your basic computer system into a real star.

And remember, all Wave Mate products meet the highest quality industrial standards, with rugged construction unmatched by anyone! Join the popularity explosion and get yours now! Write or call for more info and your closest Wave Mate authorized distributor.

You get your choice of microprocessors! And you get wire-wrapped modules too!

Now you have a low cost way to get started into personal computing without sacrificing future growth capability!

Send information on:	☐ Jupiter IIA system☐ Jupiter IIIA system	
NAME		
ADDRESS		l
CITY	STATE	_ ZIP



WAVE MATE 1015 West 190th Street, Gardena, California 90248

Dept 24

Telephone (213) 329-8941



UPCOMING COMPUTER SHOWS

Mar. 1 NEPCON '77 Anaheim Convention Center, Anaheim, CA. Microprocessor workshop seminar slated.

DPMA Computer Equipment Show and Conference. Convention Center. Sacramento, CA. For more information write SMUG, PO Box 16153, Sacramento, CA. 95816.

Computer Caravan '77 is a series of nine computer forums to be held in the following cities: Each of the Computer User Forums will be conducted by a leading user or independent consultant who will lead seminars and workshops on these relevant, up-to-date topics.

Tuesday: Case Studies in Applying Minicomputers — the minis as Mainframe; Distributed Minis (with and without) Data Communications; Organizational Impact of a Distributed Mini System.

Wednesday: Case Studies in Managing Terminal Networks—"Dumb" Terminal Networks, "intelligent" Terminal Networks; Remote Batch Systems; Communication Control Equipment.

Thursday: Case Studies in Improving Software Productivity — Personnel Recruiting, Selection and Training; Software Alternatives; Measuring Systems Utilization; Documentation and Maintenance Aids.

All Forums will take place from 9AM to 1PM. Concurrently, hundreds of exhibitor products and services will be shown at Computer EXPO 77 each day from 10AM to 5PM. There is no admission charge to the exhibit hall.

March 29-31, San Francisco Civic Auditorium.

April 5-7, Los Angeles Convention Center

April 19-21, Cleveland Convention Center

April 26-28, St. Paul Civic Center May 3-5, Chicago McCormick Place May 10-12, New York Coliseum May 24-26, Philadelphia Convention Center

May 31-June 2, Sheraton Park Hotel, Washington DC.

June 7-9, Boston, Northeast Trade Center (Rte. 128, exit 39)

Registration for any single forum day entitles you to attend all three days of exhibits. If you wish to attend the exhibits only, no advance registration is required. For registration contact:

Registration Office Computer EXPO 77 797 Washington Street Newton, Ma. 02160 617 / 965-5800

April 15-17 The First West Coast Computer Faire. A conference and exposition on personal and home computing will be held at San Francisco Civic Auditorium. For further information contact Mr. James Warren Star Rte. Box 111, Woodside, CA 94062 415/851-7075.

June 13-16 National Computer Conference. Dallas, Texas.

Directory Available For Computer Hobbyists

A directory for computer hobbyists has been compiled to help subscribers keep in touch with each other and to provide information in an easy-to-find form.

The "Personal Computing Directory" data base contains the name, address and telephone number of each subscriber. Clubs, societies, newspapers and magazines geared to the computer hobbyist will also be listed.

The directory which had its debut in February includes manufacturers, stores, repair services, conventions, courses and contests — in short, almost anything of interest or of informational value to the hobbyist.

The directory will be divided into three parts, with addresses listed geographically by ZIP Code, alphabetically and alphabetically by subject. Listing and advertising in the 200 to 300 page directory is free. The directory will be sold for \$4.95

from "Personal Computing Directory", P.O. Box 134, Harvard Sq., Cambridge Mass. 02138.

Hobbyists in Boston Get Radio Show

Computer hobbyists took to the airwaves with their own radio show which began on Jan. 22, 1977.

Believed to be the first of its kind, the "The Computer Program" is broadcast on WBUR-FM, a noncommercial radio station with a 100-mile radius in the Boston area. The format of the show will feature a guest speaker on a topic of his choice and answer questions from listeners. Richard Gardner is the Host and originator of the show.

The program includes news items of interest to the home computer hobbyist and a weekly announcement of resources related to the speakers topic.

CALL FOR PAPERS

1977 Conference on Computers in the Undergraduate Curri-cula, June 19-22 East Lansing, Michigan. Papers should be concerned with undergraduate instruction in two and four year universities in a broad array of disciplines. Those from minority institutions and small colleges will be given special consideration. Because the conference emphasizes applications of computers, computer science is specifically excluded. Papers on computer services whether from a campus center or other sources, are considered only if they have special features.

Authors should submit an original manuscript no longer than fifteen pages and four copies to Gerald L. Engel, Virginia Institute of Marine Science, Gloucester

Point, VA 23062.

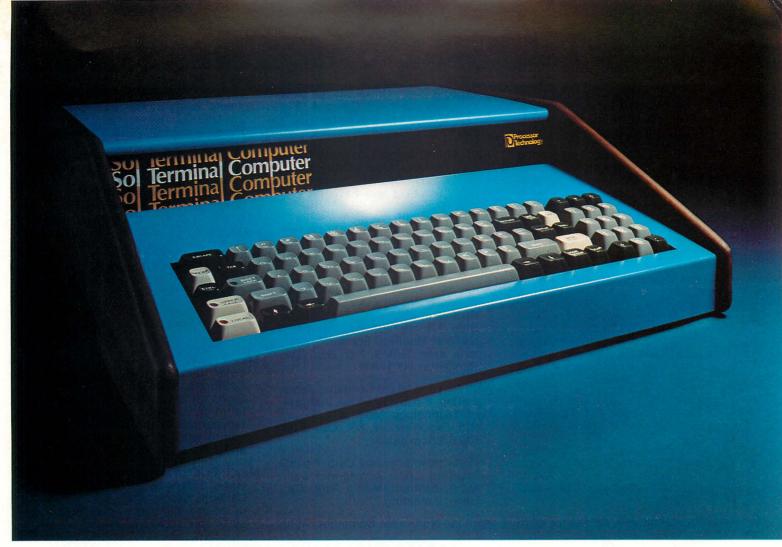
Mar. 16 Homebrew Computer Club, 7 p.m. Stanford Linear Accelerator Center Auditorium. Menlo Park, CA. General Meeting.

Mar. 16 Northwest Computer Club, 7 p.m., Pacific Science Center, room 200, 2nd Ave., N. Seattle, WA.

Mar. 18 Long Island Computer Association, 8 p.m., New York Institute of Technology, Bldg. 500, Room 508, Old Wesbury NY. Call (516) 938-6769 for details.

Mar. 19 South Central Kansas Amateur Computer Association, 9 a.m., 1430 E. Kellog (next to Church of the Nazarine) Wichita KS. Call Cris Borger (316) 265-1120 for agenda.

Mar. 22 Sacramento Microcomputer Users Group (SMUG) 7:30 p.m. meets at the Sacramento Munici-



The Small Computer

Twenty-five years ago a computer as powerful as the new Processor Technology Sol-20 priced out at a cool million.

Now for only \$995 in kit form or \$1495 fully assembled and tested you can have your own small computer with perhaps even more power. It comes in a package about the size of a typewriter. And there's nothing like it on the market today. Not from IBM, Burroughs, DEC, HP or anybody else!

It fills a new role

If you're an engineer, scientist or businessman, the Sol-20 can help you solve many or all of your design problems, help you quantify research, and handle the books too. For not much more than the price of a good calculator, you can have high level computer power.

Use it in the office, lab, plant or home

Sol-20 is a smart terminal for distributed processing. Sol-20 is a stand alone computer for data collection, handling and analysis. Sol-20 is a text editor. In fact, Sol-20 is the key element of a full fledged computer system including hardware, software and peripheral gear. It's a computer system with a keyboard, extra memory, I/O interfaces, factory backup, service notes, users group.

It's a computer you can take home after hours to play or create sophisticated games, do your personal books and taxes, and a whole host of other tasks.

Those of you who are familiar with small computers will recognize what an advance the Sol-20 is.

Sol-20 offers all these features as standard:

8080 microprocessor — 1024 character video display circuitry — control PROM memory — 1024 words of static low-power RAM — 1024 words of preprogrammed PROM — built-in cassette interface capable of controlling two recorders at 1200 bits per second — both parallel and serial standardized interface connectors — a complete power supply including ultra quiet fan — a beautiful case with solid walnut sides — software which includes a preprogrammed PROM personality module and a data cassette with BASIC-5 language plus two sophisticated computer video games — the ability to work with all S-100 bus products.

Full expansion capability

Tailor the Sol-20 system to your applications with our complete line of peripheral products. These include the video monitor, audio cassette and digital tape systems, dual floppy disc system, expansion memories, and interfaces.

Write for our new 22 page catalog. Get all the details.

Processor Technology, Box G, 6200 Hollis St., Emeryville, CA 94608. (415) 652-8080.



CIRCLE INQUIRY NO. 5

pal Utilities Department Training Building (SMUD) 59th Street between R and S.

Mar. 30 Homebrew Computer Club, 7 p.m. Stanford Linear Accelerator Center Auditorium. Menlo Park, CA. General Meeting.

Mar. 31 Small Computer Engineering Association of Minnesota (SCEAM) 7 p.m. 3010 4th Ave., South Minneapolis near Lake St. and Nicollet Ave. So. Call (612) 824-6406 for club agenda.

April 2 Louisville Area Computer Club, 1 p.m., University of Louisville, Speed Auditorium. Contact Glenn Darwin (502) 456-5589 for details.

April 3 North Orange County Computer Club (NOCCC), 12 noon, California State Univ. Fullerton. Signs will be posted at the administration building to direct interested parties to the meeting.

SCCS Valley Capter, 7 p.m., Harvard School, 3700 Coldwater Canyon, Studio City, CA.

April 6 New England Computer Society, Inc. 7 p.m., Mitre Corp. Cafeteria. Rt. 62 Bedford, Mass. Contact Dave Day at (603) 434-4239 for details.

April 6 Northwest Computer Club

7 p.m., Pacific Science Center, room 200, 2nd Ave., N. Seattle, WA.

April 8 Crescent City Computer Club, 8 p.m., University of New Orleans, Lakefront Campus. For club agenda call Bob Latham (504) 722-6321.

April 9 Oklahoma Computer Club, 10 a.m. Belle Aisle Library, Oklahoma City, OK. Al Campbell at (405) 842-4933 will have details.

April 10 South Eastern Michigan Computer Organization (SEMCO) 6 p.m., at the studios of WJBK TV-2. Call President Dick Weir at 565-3228 for details.

April 14 Rochester Area Microcomputer Society (RAMS) 7:30 p.m., Rochester Institute of Technology, Bldg. 9 Room 1030, Rochester NY. General Meeting. For further details write: RAMS, P.O. Box "D", Rochester, NY 14609.

April 15 Long Island Computer Association, 8 p.m. New York Institute of Technology Bldg. 500, Room 508, Old Wesbury, NY. Call (516) 938-6769 for details.

Homebrew Computer Club, 7 p.m., Stanford Linear Accelerator Center Auditorium. Menlo Park, CA. General Meeting.

April 20 Northwest Computer Club,

7 p.m., Pacific Science Center, room 200, 2nd Ave., N. Seattle, WA.

April 26 Sacramento Microcomputer Users Group (SMUG), 7:30 p.m. meets at the Sacramento Municipal Utilities Department Training Building (SMUD) 59th Street between R and S.

April 28 Small Computer Engineering Association of Minnesota (SCEAM) 7 p.m., 3010 4th Ave. South Minneapolis near Lake St. and Nicollet Ave. So. Call (612) 824-6406 for club agenda.

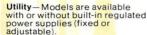
April 29 Homebrew Computer Club, 7 p.m. Stanford Linear Accelerator Center Auditorium. Menlo Park, CA. General Meeting.

May 1 North Orange County Computer Club (NOCCC), 12 noon California State Univ. Fullerton. Signs will be posted at the administration building to direct interested parties to the meeting. This month will provide a family day and software swap meet.

May 1 SCCS Valley Chapter, 7 p.m., Harvard School, 3700 Coldwater Canyon, Studio City, CA. Scheduled this month is a new product show sponsored by Signetics.



IF YOU'RE NOT DESIGNING WITH A CSC PROTO-BOARD, LOOK AT ALL YOU'RE MISSING.



Accessibility — All parts are instantly and easily accessible, for quick signal tracing, circuit modifications, etc.

Variety—A wide variety of models are available with capacities ranging from 630 to 3060 solderless tie-points (6 to 32 14-pin DIP's), to fit every technical and budget requirement.

Economy — Eliminate heat and mechanical damage to expensive parts. Save money by re-using components.

Versatility—Use with virtually all types of parts, including resistors, capacitors, transistors, DIP's, TO-5's, LED's, transformers, relays, pots, etc. Most plug in directly, in seconds.

Durability—All Proto-Board models are carefully constructed of premium materials, designed and tested for long, trouble-free service.

Expandability—Proto-Board units can be instantly interconnected for greater capacity.

Visibility—All parts are instantly and easily visible, for quick circuit analysis and diagramming

Speed — Assemble, test and modify circuits as fast as you can push in or pull out a lead. Save hours on every project.

Adaptability—Use in design, packaging, inspection, QC, etc. Works with most types of circuits, in many, many applications.

Flexibility—Use independently, or in conjunction with other accessories, such as scopes, counters, CSC Proto-Clip ™ connectors, Design Mate™ test equipment, etc. One Proto-Board unit can serve a thousand applications.

See your CSC dealer or call 203-624-3103 (East Coast) or 415-421-8872 (West Coast) 9 AM to 5 PM local time. Major credit cards accepted. Add \$2.50 for shipping and handling in the U.S. and Canada on direct orders of \$50.00 or less; \$3.00 for orders over \$50.00. On all foreign orders add 15% to cover shipping and handling.

CONTINENTAL SPECIALTIES CORPORATION



EASY DOES IT

44 Kendall Street, Box 1942

New Haven, CT 06509 • 203-624-3103 TWX: 710-465-1227

West Coast office: Box 7809, San Francisco, CA
94119 • 415-421-8872 TWX: 910-372-7992

Whatever type of electronic circuits you work with, you can do more in less time with CSC's solderless Proto-Board systems. As fast and easy as pushing in or pulling out a lead, you can design, test and modify circuits at will. Components plug into rugged 5-point terminals, and jumpers, where needed, are lengths of #22 AWG solid wire. In the same time you took to read this ad, you could be well on your way to assembling a new circuit. For more information, pick up your phon and call your dealer—or order direct.

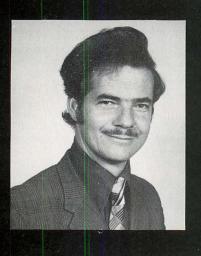
CSC PROTO-BOARD SOLDERLESS BREADBOARDS

MODEL NUMBER	NO. OF SOLDERLESS TIE-POINTS	IC CAPACITY (14-PIN DIP'S)	MANUFACTURER'S SUGG.LIST	OTHER FEATURES
PB-6	630	6	\$15.95	Kit — 10-minute assembly
PB-100	760	10	19.95	Kit — with larger capacity
PB-101	940	10	29.95	8 distribution buses, higher capacity
PB-102	1240	12	39.95	Large capacity, moderate price
PB-103	2250	24	59.95	Even larger capacity: only 2.7¢ per tie-point
PB-104	3060	32	79.95	Largest capacity: lowest price per tie-point
PB-203	2250	24	75.00	Built-in 1%-regulated 5V, 1A low-ripple power supply
PB-203A	2250	24	120.00	As above plus separate $^{1}_{2}$ -am $+15$ V and -15 V internally adjustable regulated power supplies

© 1976 Continental Specialties Corp.
Prices and specifications subject to change without notice.

... FROM THE FOUNTAINHEAD

By Adam Osborne



What Will Happen to Computer Stores? By Adam Osborne

Instead of picking up on small news items from Silicon Valley this month I shall examine the future of the computer store.

Is the computer store a passing phenomenon whose existence is based on the euphoria of a new industry — and investors with money to lose? Or is the computer store a new component of the computer and electronics industry whose day has come?

Will computer stores last only until store owners have lost enough money to become convinced that the idea has no future? Or are the struggling store owners of today the successful businessmen of tomorrow?

My prognosis is highly optimistic from the store owner's point of view. I believe the computer store is an entity whose time has come and whose economics are valid. Anyone currently starting a computer store has an excellent chance of doing very well over the next five years, providing they run their business based on sound financial principles.

Let me explain the reasons for my optimism. When you buy something in the store you pay for goods, and providing what you buy works, you pay for all subsequent service. This is true for a television, a stereo sound system or an automobile. Yes, an automobile dealer has a shop which sells cars.

But until the advent of the computer store, if you wanted to buy a computer system, you went to the manufacturer and placed your order - or occasionally you went to an authorized distributor. In other words, there was no difference between a company buying 100 computers per month to put in the bank terminals, or you buying one to run payroll.

Now a manufacturer buying 100 computers per month knows exactly what he plans to do with the computers. Providing he receives hardware that works, he is satisfied. He does not ask the computer manufacturer for programming assistance, nor for any other form of post-purchase support. He pays his bills and is not heard from again.

The guy who buys one computer, or just a few, is another story. To him the thousands of dollars he has paid is a large sum of money — In his opinion is buying a solution to a problem and not a computer at all. A small businessman, for example, buys a computer system for \$30,000 in order to do his in-house data processing. He is not buying a computer, he is buying a solution to his bookkeeping problems; and therein lies the problem. The small buyer does not fully know what he is buying. Nevertheless he will give the seller endless problems, and refuse to pay his bill until he gets what he wants - even though he does not really know what he wants. The small buyer who buys one computer system, or very few computer systems, is the source of financial ruin to computer manufacturers, distribution companies and software companies alike; he demands all kinds of

PRIME RADIX

ANNOUNCES GALL THE GALL TM

WE DO IT WITH MIRRORS!

(and some very sophisticated state-of-the-art memory design)

65,536 BYTES

Your dream can be a reality with the Prime Radix Corporation's $64K_{TM}$ memory system at a very cost-effective price. And because it is a standalone memory system, you've got the advantage of greater flexibility not ordinarily available from add-in memory. Some of the features are:

- The 64KTM is fully buffered, presenting one TTL load to the memory bus.
- The 64KTM is digital group bus and ALTAIRTM bus compatible.
 When ordering, you must specify the bus architecture. A plugcard and cable will be furnished for the particular bus architecture you specify.
- 64K_{TM} is expandable to larger word lengths (16 bits; 24 bits; 32 bits; all organizations with or without parity). Other bus compatibilities will be available soon.
- The minimum complement of memory is 40K BYTES, with starting address locations at 0K, 8K, 16K, or 24K.

- The 64KTM comes assembled and tested with its own power supply, attractively housed in an aluminum cabinet, ready to plug into your system. With a choice of a freestanding cabinet or a 19" rack-mountable cabinet, 5"h x 18"w x 14"d.
- Psuedo-static operation: on board refresh clock-generator provides processor independent refresh with no wait states. The 300NS worst case access time enhances high speed operation.
- Power/fail detection circuitry and battery backup will provide non-volatile memory (batteries are optional at extra cost).
 LIST PRICE IS AS FOLLOWS:

40K 48K 56K 64K \$1490.00 \$1580.00 \$1670.00 \$1750.00

We are offering a special introductory ten percent discount off list price on all orders received on or before March 31, 1977. Delivery will be made in the same sequence as orders are received. Please allow 3 to 6 weeks for delivery. Mastercharge and BankAmericard are accepted.

• Prime Radix, Inc. • P.O. Box 11245 • Denver, CO 80211 • (303) 573-5942 or (303) 433-5630 •

City State	Zip	(P	lease No C.O.D.'s or P.O.'s)	Signature
Address			Check or M.O. enclosed Charge BAC Charge MC	4 Numbers Above Name (MC)Good Thru
Print Name			40K @ \$1490.00	Credit Card Number
			48K @ \$1580.00	
			56K @ \$1670.00	or 433-5630
COMPUTER SYNTI	HESIS		64K @ \$1750.00	Denver, Colorado 80211 (303) 573-5942
PRIME R			ALTAIRTM BUS	PRIME RADIX, INC. P.O. Box 11245
			DIGITAL GROUP BUS	Make checks or money orders payable to:

MARCH 1977 CIRCLE INQUIRY NO. 8 INTERFACE AGE 11





- USES 4K STATIC RAMS NO REFRESH
- VERY LOW POWER LESS THAN 1 AMP
 Z80 FAST 200ns ACCESS TIME
- PROVISION FOR BATTERY BACKUP
- LOW PROFILE SOCKETS FOR ALL CHIPS
 EACH 4K ADDRESSABLE TO ANY 4K SLOT
- HARDWARE/SOFTWARE MEMORY PROTECT FOR EACH 4K

 • SPECIAL PAGING OPTION ALLOWS UP TO
- MEGABYTE ADDRESSABLE MEMORY
- LOW COST

CONSTRUCTION MANUAL	,	
PAGING OPTION		,
QUANTITY DISCOUNT		5

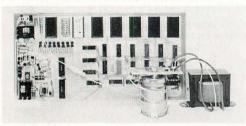
\$1.75 \$9.00 5 BOARDS — 5% 10 OR MORE — 10%

DEALER INQUIRIES INVITED

OMNI SYSTEMS INC. P.O. BOX 7536, UNIV. STATION **PROVO, UTAH 84602**

CIRCLE INQUIRY NO. 9

PRAMMER by Xybek



- 1702A PROM PROGRAMMER, 1792 bytes of 1702A EPROM, and 256 bytes of RAM, all on one board. The programmer is not an I/O device. At the flick of a switch, one of the 1702A positions becomes a With programming enabled, programming address. storing into this address space will program the PROM. With programming disabled, that address space is just ordinary read-only memory.
- Because PRAMMER contains its own clock and microprogram for read-write control, it will, through the S-100 bus, interface with any CPU.
- * The kit comes complete with one 1702A containing stand-alone software for programming other 1702A's and a complete source listing of an eleven-function development system which fits into the 1792 bytes of PROM space.

COMPLETE KIT: Introductory Price......\$189

Master Charge and BankAmericard accepted. California residents please add sales tax.

XYBEK • P.O. Box 1631 • Cupertino, CA 95014 Telephone (408) 296-8188

CIRCLE INQUIRY NO. 10

service after the purchase, expecting to get it at no additional cost. In effect, the small computer buyer expects to pay a fixed price for an unknown amount of service - and that has lead to the financial collapse of companies catering to this customer base. The only cost effective way of selling computers to the new generation of computer consumers is to sell computers the way General Motors sells automobiles. Sell the computer as is, through a retail outlet. Subsequentially charge by the hour for all levels of service and support. Sell small computers systems at low cost, with a built in profit, then charge time and materials for programming and service, and you will make a profit. Charge a higher fixed price for the computer system, include an unspecified amount of the sales support in this higher fixed price and you stand a good change of losing money. I doubt if many of you can argue with that statement. The questions you may legitimately ask are:

- 1) Will customers stand still for this new set of selling rules - which make computers inherently more expensive?
- 2) Supposing you can get customer acceptance, will manufacturers go through computer stores rather than sell direct?
- 3) Who are the customers we are talking about anyway? Are there enough of them to warrant anyone's attention?

Let us take these questions one at a time.

First of all let us discuss customer acceptance of the new selling rules.

There are two reasons why customers will accept such selling rules:

First, stores can afford to sell computer systems at beguilingly low prices.

Second, anyone who continues trying to sell the old way will quickly go bankrupt and disappear from the scene - just as all his predecessors have.

So why won't the manufacturers sell direct? The reason is because retail outlets are expensive. Assuming there are ten manufacturers of small computer systems, if each sells direct, then each must have its own network of stores. One general store may serve a large number of customers: that will reduce the number of stores — which must be inherently cheaper. Customers would far rather go to one store, and see all ten computer models, as against having to visit ten stores. Just as successful stereo system stores sell a variety of models, so successful computer stores will sell a variety of computers. Furthermore, if computer stores are run as private enterprises, the computer manufacturers are relieved of cost associated with managing these computer outlets and ensuring that they are being run honestly.

Who then are the customers? Broadly they fall into three groups:

1) There are small industrial manufacturers. These customers do not buy computers in sufficient quantity to get any reasonable discount from the minicomputer manufacturer.

This being the case it is just as attractive to run down when needed and buy hardware from the local computer store, rather than to administer a large number of purchasing small contracts with manufacturers and hold the necessary inventory. Also, a large number of these small industrial customers are buying computer hardware for the first time. It was not until the advent of the microprocessor that computer hardware became cheap enough for numerous industrial concerns. These industrial concerns buy a great deal of know-how when they go down to a computer store to buy a card, rather than designing logic from components — the way people did in the past.

- 2) There are the small businessmen and the single computer system users who will buy a single system from a computer store because the initial price is very attractive. This may at first appear to be a scam, because the subsequent hidden costs are so high. But in reality it is no scam. The same customer going to a small computer systems company is also likely to get an unrealistically low initial system price. Ask almost any small computer user what his computer system cost in the end; he will either tell you that it cost far more than was first quoted, or he will tell you that the computer system company lost a pile of money keeping its obligations, at which they either went broke or chose another business.
- 3) Then there are the "hobbyists". I am sure there are people buying computers in order to play "StarTrek" but I suspect that those hobbyists who are investing any significant amount of money in their computer system are doing so in the hopes of making this expensive hobby ultimately pay for itself. And here is the beauty of the computer store — it gives the hobbyist the opportunity to see his hobby pay off.

The first and second categories of computer buyer described above are a very fertile market for hobbyist to whom to sell programming and design expertise. A hobbyist would be very pleased with \$3,000.00 gross earned over three months of evenings and weekends spent creating business programs for the local pharmacist. Not only would these \$3,000 represent useful income, but the time spent generating this income would be fun, not work. Any established software company could not possibly compete with the hobbyist in a market like this; a company that is going to operate as a profitable business venture will finish up spending anywhere between \$10 to \$25 per byte of object program. Companies who claim to do it for less are either most unusual or have not been in business long enough to see their jobs finally close. Now you may argue that a computer buyer would rather go to a small company and pay more money as against going to a hobbyist who may be here today and gone tomorrow. That argument would have some validity except that small software companies are

11111

comptek Boards DO Something

CL2400 Real Time Clock

\$98-Kit

\$135—Assembled

If your system needs to know what time it is, our CL2400 is the board for you. The present time in hours, minutes, and seconds is always available for input, and is continuously updated by the highly accurate 60 Hz power line frequency. Need periodic interrupts? The CL2400 can do that, too, at any of 6 rates. Reference manual with BASIC and assembly language software examples included.



PC3200

Power Control System

PC3232 \$299—Kit PC3216 \$189-Kit

\$360-Assm.

\$240-Assm. PC3202 \$39.50-Kit \$52—Assm.

If your system needs on/off control of lights, motors, appliances, etc., our PC3200 System components are for you. Control boards allow one I/O port to control 32 (PC3232) or 16 (PC3216) external Power Control Units, such as the PC3202 which controls 120 VAC loads to 400 Watts. Optically isolated, low voltage, current-limited control lines are

comptek

standard in this growing product line.

"Real World Electronics"

P.O. Box 516 La Canada, CA 91011 (213) 790-7957

CIRCLE INQUIRY NO. 11

MORE POWER TO YOUR ALTAIR*

12 AMPS @ 8v. (nominal) 2 AMPS @ ± 16v.

At any line voltage from:

90 to 140 volts.

Installs easily inside any Altair* 8800 or 8800a.

Over voltage and over current protected.

Conservatively designed and specified.

only \$90.00

postpaid in the U.S.A. California residents add \$5.40 sales tax.

BANKAMERICARD

PARASITIC ENGINEERING

PO BOX 6314

ALBANY CA 94706

*Altair is a trademark of MITS Inc.

CIRCLE INQUIRY NO. 12

ANNOUNCING!



CONVERT ANY TV

TO A HIGH RESOLUTION MONITOR

Easy Assembly — Easy on the Budget

TRVM-1 Hi-Resolution \$19.95

Transformer isolated sets only.

HCVM-1 Hi-Resolution \$23.95

For EITHER transformer isolated sets, or "HOT" chassis type sets.

RFVM-1 RF Modulator \$8.95

Ch. 2 thru 6. Any TV source or set.
INSTRUCTIONS INCLUDED
SHIPPING EXTRA, ADD \$1. (Foreign Orders \$2)

VAMP Inc.

P.O. Box 29315 Los Angeles, CA 90029 DEALER INQUIRY WELCOME

CIRCLE INQUIRY NO. 13

YOU Asked For It

OUR PLOTTER KITS ARE NOW 90% ASSEMBLED AND TESTED (AT NO INCREASE IN PRICE).

SEE PAGE 68 FOR FURTHER DETAILS.

Sylvan Hills Lab Inc. #1 SYLVANWAY, BOX 239 STRAFFORD, MO 65757 PHONE 417-736-2664

CIRCLE INQUIRY NO. 14

also here today and gone tomorrow. The truth of the matter is that the hobbyists offer the small customer everything the small company does, but at a fraction of the cost. For small logic design jobs the same economics is likely to hold true. The only time consulting companies pay their way is when the product has to be very well designed — for example when it is going to be manufactured in high volume where small savings per unit count, or where the application is a very difficult one that can only be solved by someone with a considerable amount of expertise.

Thus there is a very bright future for the hobbyist who wishes to make money out of his computer hobby. There is a huge market for programming and logic design skills available to the hobbyist. Unfortunately, the hobbyist's good fortune is the small company's misfortune. Small consulting firms and software houses who have not established an excellent reputation will simply go out of business when faced with the onslaught of competition from the emerging hobbyists.

What then does this mean to the computer store owner? What is his strategy for financial success?

First of all, like any other business, the computer store must be operated in a sound financial manner. It doesn't matter how viable a business may be, if mismanaged it will fail. Make sure your store is located close enough to a customer base to give you the volume you need, then organize your business on sound financial lines. If you do not keep sharp control of your inventory, pay bills on time and plan your cash requirements in advance, making certain that you will have money when you need it, then you will fail.

Assuming that you know how to run a business then what should you sell? Hardware AND programming services? Indeed, no. Confine yourself to selling hardware and to fixing hardware - for a fee. The moment you start going into the programming business you become a small software company, doomed to failure from the competition from the hobbyists. Instead of offering programming services yourself, and that means going into competition with the hobbyist who are your customer base, support your customer base. Have a corkboard in the store where hobbyists can pin cards describing the services of your hobbyists and you will make far more money by giving the hobbyists economic survival then you would by taking profit from them.

The future success of the computer store, therefore, is based on the ability of the computer store to sell a wide variety of computer products on a cash and carry basis. The difference between what you charge and what you pay is your profit. There are no subsequent hidden expenses. Under no circumstances should you allow such subsequent hidden expenses to arise. Build a growing customer base of hobbyists who work as part-time consultants. If you encourage this customer base, then computer stores will solidify their position as a necessary and viable economic entities within the appell computer industry.

within the small computer industry.

MENACE OF THE MICROWORLD

This program works—not despite its imperfections—rather because of them

Ken Berkum

What's the glamour field of computer science? Is it Assembly Language? Operating systems? Compilers? No, it's Artificial Intelligence.

Artificial Intelligence — even the words sound mysterious. To create a thinking, reasoning machine, what could be more ambitious and rewarding?

It's still a long way off, and as if to prove that, the majority of all papers published in the field concern themselves primarily with merely defining artificial intelligence, or even intelligence. There is no simple definition and it may be irrelevent when or if it ever is defined.

It would be neat to have your Altair respond to spoken commands in English, fix your breakfast and wash the dishes, but is that reasonable? This article will look at one aspect of Artificial Intelligence (or AI) that can be demonstrated on your micro. But don't expect it to clean your room.

Intelligence may be defined as, among other things, the ability to solve problems and to learn. Certainly there are some elements of this in humans (contrary to popular belief about some human groups like politicians and college students). One of the best ways to combine problem solving and learning is in game playing. With a game one must first learn the rules, solve the problem of winning, and learn strategy all along the way.

Examining this we find three areas: 1) rote learning, 2) problem solving, and 3) learning by experience. Cases can be made for all three, but I find learning by experience to be the most fascinating of all. The human mind appears capable of all types of learning, and by and large, most computers are capable of rote learning. Indeed, entering a machine language program into memory is an example of rote learning. With people it is not even that simple, for instance repeating a telephone number over and over again, until they are done dialing.

Game playing may be one of the first things machines were asked to do to prove their intelligence. Chess machines date from the earliest days of computers. Even now chess programs are extremely popular and improving their play dramatically. There are even limited chess programs available for the 8080. These play with a reduced board and reduced number of pieces (also huge

amounts of memory). Chess programs in the early to mid Sixties were hailed as the vanguard of Al. Now they are relegated to a much lower status even as their playing ability improves.

The BASIC program that follows this article is no chess program, but it does demonstrate some of the techniques used in games programming, and provides an important insight into the origins of some elementary computer learning theories. The program, called Machine/Menace is a Tic-Tac-Toe program.

Tic-Tac-Toe? What's so exciting about that? I hear you cry. Any beginning programmer can write a Tic-Tac-Toe program that plays a perfect game, winning when the user makes just one mistake, and otherwise drawing.

This is a special program however. It does not know how to play that perfect game. As a matter of fact, all it knows is that you can not go twice in the same square, nor where the other person has played, and to win you must get three in a row. Based on that knowledge alone the program learns to play Tic-Tac-Toe, so that soon it too is playing a perfect game. The program demonstrates rote learning, the rules mentioned above, problem solving, deciding what move to make next, and learning by experience as it develops a strategy.

Before describing the program and how it works, I will give a brief background. More information is available in the excellent book "On Machine Intelligence" (1974) by Donald Michie.

The program is a computer simulation of a machine that was actually built to do nothing but learn to play Tic-Tac-Toe, ("Naughts and Crosses" in Great Britain). This was built by Michie in the early Sixties. It consisted of almost 300 matchboxes glued together and many, many small colored beads. It worked as follows: Each box corresponded to one possible configuration of the board. Since the machine, known as Menace, was always allowed first move this eliminated half the possible configurations, and rotations and reflections eliminated the rest, down to some 280-odd possible boards. By configurations I mean patterns of X's and O's as could possibly be created by two playing people.

There were nine different colors of beads. Each square of the board corresponded to one color. Therefore all possible legal moves for any one configuration could be represented by the beads of the colors of squares not in use at that time (see Diagram 1). For each matchbox, then the legal moves were represented by beads, and those beads were placed in the matchboxes. Each box had a little funnel arrangement so that when it was pulled out a single bead would fall down at random and be chosen. The square thus designated was then the machine's move.

DIAGRAM 1

RED	BLUE	GREEN
1	2	3
ORANGE	PINK	WHITE
4	5	6
YELLOW	PURPLE	BLACK
7	8	9

RED RED RED RED PINK PINK PINK BLUE BLUE BLUE BLUE BLUE BLUE A (1, 1) = 4 A (1, 2) = 4 A (1, 5) = 4

Diagram 1 shows how the squares are numbered and colored the beads assigned to each. The following diagram shows how the matchbox for position one is set up.

A piece of paper was then marked with the machine's move, and the human player (Michie) would mark down his move. Then the new matchbox was determined (after deciding which reflection was correct), play continued.

Finally either Menace won, Michie won, or the game was a draw. If a draw, nothing happened and the next game was started. However in the case of

a win or a loss Menace needed some feedback so that it could improve its game. In the case of a win it would be useful to encourage that sequence of moves that leads it to the win. Specifically the closer to the end of the game, the more important the moves were to the win. On the other hand, if the machine lost it would be desirable to discourage those moves that lead to the loss. Michie decided on a simple reward and punishment scheme. If Menace won he added a bead to each box that was left open indicating it was used, and if it lost then he removed a bead from it.

Now the trick was to make the later moves count more heavily. He did that when he calculated the number of beads to place in each box to initialize the system. Each box can be characterized by the number of moves made in the game up to that point. It will always be less than 4. Very simply, Michie started with 4 beads in a one move box, 3 in a two move box, and so on up to one in a four move box. In this way Menace was allowed one poor move if it resulted directly in a loss, but up to four chances if the move occured early in the game. Note that the reward and punishment beads were added or removed to all the boxes that were used during that game, and the bead the color of the square that was used.

Thus Michie ended up with a machine that (relatively) rapidly learned to play Tic-Tac-Toe, and after a mere 200 games was playing on an equal footing with its creator. All this from some match boxes. Machine/Menace the program presented here, simulates Menace in BASIC for use on a mini

or micro computer.

All effort was made when writing this program to use standard BASIC instructions. Although the machine I was using, a Burroughs B6700, allowed such things as matrix operations and disc usage, this version should run on any micro or mini with enough memory.

Unfortunately, that clause about the memory may eliminate many people. The program uses several arrays, one of them at least 100 by 9! The only way around this is to have disc or some other large scale rapid access memory. A cassette unit will not do because the program reads the array many times per move, and reading in from a tape would take forever to play a game. People with a floppy will have little trouble interfacing this program to it.

The program works very much like the matchbox version. Following are some programming details, and the comments in the code also describe

how it works.

First it initializes the current board and all it's counters, then starts to compute its move. Note that it keeps track of games won, lost, drawn, and total played. The board format is as follows. Matrix BO is the board. If a cell contains a -3 then no one has played there. If it contains a -1 then the program has played there, if it contains a -2 then the player has played there. Next it proceeds to check as to whether it has encountered that particular board layout before. The array A contains all the boards that have been previously used. Obviously the more one plays, the larger A grows, although this is not always true, as we shall see later on. Michie's

ability.

It Comes Naturally With The Altair™ 8800b

The Altair 8800b from MITS: the second generation design of the microcomputer that started it all. The mainframe that has the abilities everyone is demanding from microcomputers today:

Expand-ability:

The Altair 8800b power supply and onepiece, 18-slot motherboard allow efficient and easy expandability for memory and I/O options. All Altair PC boards are designed to give you maximum capability/lowest power usage possible per board. This means that for each slot used you get more features and require less power, than with any of the "offbrand" Altair-bus-compatible boards.

Whether you buy an entire system up front or choose to expand gradually, it's easy to get the configuration you need with the complete family of Altair peripheral equipment,

including floppy disk, line printer, audio cassette record interface, A/D converter, PROM programchoice of four different memory boards and many others.

Reli-ability:

The unique design features of the Altair 8800b, which have set the standard for the microcomputer industry, make it the most reliable unit of its kind. The Altair 100-pin bus, the now-standard design used by many imitators, has been "standard" all along at MITS. The unique Front Panel Interface Board on the Altair 8800b isolates and filters front panel noise before it can be transmitted to the bus. The all-new CPU board utilizes the 8080A microprocessor, Intel 8224 clock generator and 8216 bus drivers.

Flex-ability:

Meeting the diversified demands of an everincreasing microprocessor market requires flexibility: not just hardware flexibility but software flexibility as well. MITS software, including the innovative Altair BASIC language, allows the full potential of the Altair 8800b computer to be realized.

8K ALTAIR BASIC has facilities for variable length strings with LEFT\$, RIGHT\$, and MID\$ functions, a concatenation operator, and VAL AND STR\$ functions to convert between strings and numbers.

Extended ALTAIR BASIC allows integer, single and double precision variables, automatic line numbering and renumbering, userdefined string functions, PRINT USING for formatted output and a powerful EDIT command for editing program files during or after entry. Extended statements and commands include IF . . . THEN . . . ELSE, LIST and DELETE program lines, SWAP variables and Trace On and Off for debugging.

Disk ALTAIR BASIC has all the features of Extended BASIC with the additional capability to maintain sequential and random access disk files. Utilities are provided for formatting disks and printing directories.

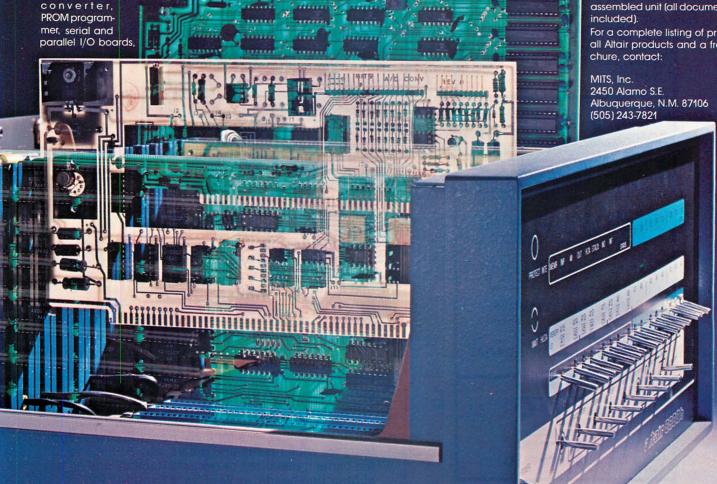
In all versions of ALTAIR BASIC you get the ease and efficiency of BASIC for the solution of real world problems.

Package II, an assembly language development system for the Altair 8800b, includes system monitor, text editor, assembler and debug.

Afford-ability:

Prices for the Altair 8800b start at \$840.00 for a kit and \$1100.00 for an assembled unit (all documentation included)

For a complete listing of prices on all Altair products and a free bro-



ROBOTS

are almost within our reach and we within theirs

Intelligent machines — machines that sense, decide, work, do battle (but don't vote) — are being developed now in the laboratories of governments and industries and on the workbenches of thousands of free citizens exercising their freedom in the new field of personal computing. Robots are on our doorstep — "for good or for ill."

USRS is established "for good" the good of Mankind — not in opposition or advocacy (opposition is idle, advocacy unnecessary) but to gather information and report to all who can face the Age of the Robot with the appropriate curiosity and spirit of adventure. We invite your support and active participation. Charter membership and first-year dues \$12. Details with your certificate.

United States Robotics Society

A Non-Profit Organization Glenn R. Norris, President Box 26484 Albuquerque, New Mexico 87102



CIRCLE INQUIRY NO. 16

matchboxes only existed for certain positions and their reflections. I found it more convenient to check for positions and their rotations. First the program checks the board against its store of boards; if it is not found then it rotates it clockwise and tries again. It continues in this way until it is back to starting position, at which point it rotates the board counter-clockwise until back home.

It is an exciting thought that you can teach an old computer new tricks

At this point it has either been found, in which case play continues, or not found, in which case the current board is entered in matrix A and the number of boards found, T4 is incremented. Then play continues. Here is how I swung the bead trick. Notice that the player indication is by the storage of negative numbers. When the program encounters a positive number then it counts those as beads. It knows what color the beads are, by which cell they are in. Thus if position 1 is red, and BO(1) = 4 then that board configuration contains 4 red beads. When a board configuration is created and stored in matrix A the number of beads and their colors are calculated and included. Notice also, that board #1 is created as part of initialization.

The results of all this are new boards being created and stored only when a new unique situation occurs. And one other odd thing: when you display a board that has been rotated it will display in the new position. This can be confusing at first, but saves a lot of precious programming space. Just remember, if the board suddenly looks much different, it is because it is rotated, but it is still the same configuration.

Once a board has been found or created then the machine must make its move. It chooses randomly among the available squares, but it is weighted towards the ones with more beads. To accomplish this I sacrificed memory for speed. The program fills an array, Q, with each board position that is available. It does this 12 times, where 12 is the number of beads in that square. Therefore if there are C1 total entries in Q a random number between 1 and C1 will choose a position from those stored in Q that is weighted according to the number of beads in each square. It could be done without the matrix Q to save memory, however the algorithm takes time, which is also at a premium in a micro.

Operation is straightforward from there on out, the machine asks for input from the player, and tests for wins losses and draws, etc. At the end of the game it penalizes or rewards itself by adding or subtracting beads, as kept track in matrix R2.

The program is set up not so much to provide an enjoyable game, as to be guick and easy to use. The board prints out -3's where a space is empty, as that is what is the matrix BO and no formatting is done. After all it may be necessary to play some 100-200 games to get good results.

You may not want to play all those games at once, so it would be worthwhile to dump array A,T4,G,W1,L, and D when you get tired and re-load them to continue. Since A is a large array, some sort of mass storage, such as a cassette or floppy would be best. The comments in the BASIC program show where to insert your own specific dump routine.

In my own tests, the first time I started playing after about 70 games I had taught Machine/Menace to either draw or resign depending on my first move! If it saw it could draw it would do so, otherwise it ended up with no beads left in any squares. and that signals it to resign. It knows it can't win.

In later experiments I spent time attempting to teach it strategy, so that it would play to win not just to draw. I was somewhat successful, but need still more games to tell for sure. I would enjoy hearing from people who use this program to see

what kinds of results they get.

To test the intelligence of this program a serious effort of teaching would be needed. One could try teaching different strategies, and even different games to it. Of great use would be another program to play the opposite person with Machine/Menace. Together they could run off thousands of games and test trends of valid statistical meaning. One could even design a program that plays at different levels of experience, up to the perfect game, to see how Machine/Menace racks up against a pro.

The purpose of this program is not to produce a HAL or a Mike (of Heinlien fame), but to show how, in a small way, even micros can do impressive things. I found myself cheering the computer on as it scored a victory over me or made a brilliant move. Furthermore, this program could be used to teach any kind of variation of Tic-Tac-Toe, and modifications could allow it to learn many other games as well.

There is no one that would call Machine/ Menace intelligent, and yet it does demonstrate learning, both rote and through inference and it certainly learns a strategy as it proceeds. What else is required of intelligence? Decision making? Memory? Stimulus and response? All these Machine/Menace does. Something seems to be lacking however.

As a last ditch effort to define intelligence I leave you with this classic problem: Which is more intelligent a chess program that plays a perfect game, but refers to the pieces by number and letter and has no display of the goings on, or one which plays fair to middling but reaches out with a hand and moves the pieces on a board, while observing what the other player moves?

This is the merest beginning of Artificial Intelligence on the micro computer. It just scratches the surface of this vast field. Nonetheless it is an exciting thought that you can teach an old compu-

ter new tricks.

YOU'VE SEEN THIS PRINTER AT TWICE THE PRICE ...



NOW ONLY \$276.00* NEW! NOT USED! COMPLETE! **EXPANDOR PRINTER**

- Operates at 10 CPS
- Prints 80 positions wide-10 CPI
- Pin feed platen included
- 8 Bit parallel interface included
- 64 Character ASCII code set.

(P.S. It's compatible with the PortaCom.)

Cover Optional at \$29.50

* Pa. residents add 6% sales tax.

CHECK...MONEY ORDER...BANK AMERICARD... MASTERCHARGE

EXPANDOR INCORPORATED

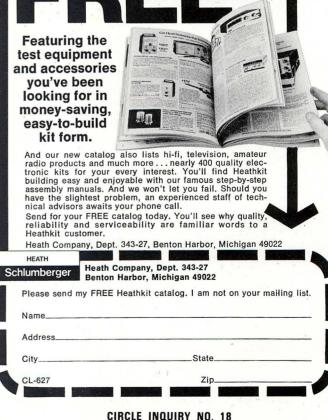
Dept. 222, 612 Beatty Road, Monroeville, Pa. 15146 Telephone: (412) 373-0300

CIRCLE INQUIRY NO. 17

the new

Heathkit

catalog!



GAME IS A DRAW No PRINT BOARD YES WIN? NO INPUT MOVE NO LEGAL? YES PRINT STATISTICS & REWARD NEW GAME? YES YES W. L. D? DONE

Figure 1.

MACHINE/MENACE FLOWCHART

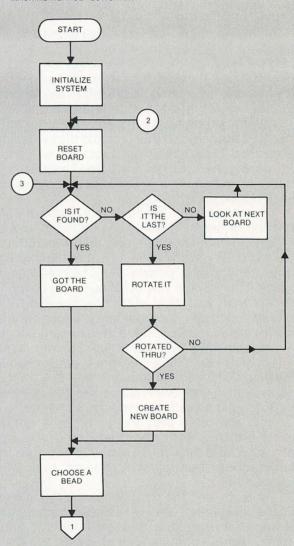


Figure 2.



Guess who just bought our new Microfloppy for \$1095 including software?

Plug-compatible for \$1095

iCOM's brand new Microfloppy[™] is specifically designed for the personal computer user. It's smaller, using the new 51/4-inch diskette, and is priced at only \$1095 including disk drive, power supply, cabinet, controller/interface card, all cables and connectors, plus, on diskette, iCOM's new FDOS-M software, including assembler, editor, and file manager. And for a limited time, you also get an 8K Disk BASIC package at no extra cost.

Best of all, iCOM's Microfloppy™ is fully assembled and tested. It's 100% compatible with Altair, IMSAI, Poly 88 and other microcomputers using the Altair bus format.

Much faster than a cassette This compact, economical Floppy Disk System is 10 to 15 times faster than a cassette. Programs can be loaded in seconds, a source program of several thousand characters can

be corrected and a new file stored on diskette in less than a minute. Any of up to 175 files can be reached in 1.5 seconds.

iCOM — the leader

We've been building Floppy Disk Systems for microcomputers for nearly three years. Thousands of our systems are operating perfectly in the field. Many major computer manufacturers have incorporated our Floppy Disks into their systems. We deliver, and we'll be around to give you service whenever you may need it. You see, we're a division of Pertec Computer Corp., one of the largest and most respected manufact-

urers of peripherals, microsystems, data entry products, and data processing systems.

So you don't need to risk getting burned by a fly-by-night company. Order an iCOM® Microfloppy® and be sure of getting the best.

See iCOM's Microfloppy[®] now at your local computer store. Or contact us for the name of your dealer.



*Offer good through April 15, 1977



a division of Pertec Computer Corporation

6741 Variel Ave., Canoga Park, CA 91303 U.S.A. (213) 348-1391 TWX 910-494-2788

MARCH 1977 CIRCLE INQUIRY NO. 20

```
L
10 REM HACHINE/MENACE
15 KEN BERKUN
20 DIM BO(9),A(300,9),E(9),R(9,2),Q(100)
30 KEM INITIALIZE THE FIRST BOX. SQUARES 1,2, AND 5 ARE THE
40 REM ONLY UNIQUE STARTING POSITIONS (SEE TEXT)
50 A(1,1)=4
60 A(1,2)=4
70 A(1,5)=4
60 REM TH IS NUMBER OF BOARDS CREATED
90 TH=1
                                                                                                                                                                                                                                                                                                                                                                                                                       1220 REM THE SUBROUTINE CALLED PRINTS OUT THE BOARD 1230 GO SUB 1490
                                                                                                                                                                                                                                                                                                                                                                                                                     1230 GO SUB 1490

1240 REM THIS SUBROUTINE CHECKS FOR A WIN LOSS OR DRAW
1250 REM IF W IS SET TO -1 THEN THE PROGRAM WON, ELSE GO ON
1260 GO SUB 1700
1270 REM LINE 2120 IS THE WIN CONDITION
1280 IF W = -1 THEN 2120
1290 FOR I = 1 TO 9
1300 REM IF THERE IS STILL AN EMPTY SQUARE THEN LET THE HUMAN GO
1310 IF BO(1) = -3 THEN 1350
1320 NEXT I
1330 REM ELSE A TIE AND GO TO 2230 FOR THAT CONDITION
1440 GO TO 2230
1350 PRINT "YOUR MOVE"
1360 REM INPUT USER'S MOVE
 90 T4=1
100 REM G IS TOTAL NUMBER OF GAMES
110 G=0
120 REM W 1 IS # GAMES WON
130 W 1=0
140 REM L IS # GAMES LOST
                                                                                                                                                                                                                                                                                                                                                                                                                      1350 FRINT "TOUR MOVE"
1360 REM INPUT USER'S MOVE
1370 INPUT MO
1380 REM IF ILLEGAL THEN THY AGAIN
1390 IF BO(MO) <> -3 THEN 1290
1400 REM ELSE SET THAT SQUARE TO A -2 TO SHOW IT'S IN USE
   150 L=0
    160 REM D IS # GAMES DRAWN
                   HEM FILL THE BOARD WITH -3'S EMPTY SPOTS
FOR 1 = 1 TO 9
BO(1) = -3
                                                                                                                                                                                                                                                                                                                                                                                                                    1400 REM ELSE SET THAT SQUARE TO A -2 TO SHOW IT'S IN USE
1410 BO(MO) = -2
1420 REM THEN TEST FOR WIN, ETC. NOTE THAT BOARD IS NOT PRINTED
1430 GG SUB 1700
1440 REM IS W = -2 THEN HUMAN WON
1450 IF W = -2 THEN 2290
1460 REM ELSE GO BACK AND LET THE MACHINE DO IT AGAIN
1470 GO TO 280
1480 REM PRINT SUBROUTINE. NOTHING FANCY. EASY TO CHANGE
1490 FOR I = 1 TO 3
1500 PRINT BO(1);
1510 NEAT I
1520 PRINT
1530 FOR I = 4 TO 6
1540 PRINT BO(1);
1550 NEAT I
200 BU(1) = -3
210 FOR K = 1 TO 2
220 REM ARHAY K2 IS USED FOR COMPUTING REWARDS/PUNISHMENTS
230 K2(I,K)=0
240 NEXT K
250 NEXT I
260 K1=0
  270 REM EVERYTHING SHOULD BE CLEARED BY NOW
270 REM EVERYTHING SHOULD BE CLEARED BY NOW 280 PRINT "MY MOVE"
290 REM ALGORYTHM IS AS FOLLOWS: IF THE BOARD MATCHES A(J,*) THEN 300 REM YOU'VE FOUND IT, ELSE TRY THE NEXT STORED PATTERN, WHEN 310 REM DONE WITH THOUSE ROTATE THE CURRENT ONE (BO) AND STAHT AGAIN 320 REM LINE 990 IS A SUCCESS 330 FOR R = 1 TO 8 400 REM THIS LOOP IS FOR ROTATING 350 FOR J = 1 TO T4 400 REM THIS LOOP IS FOR THE THING STANDARD TH
                                                                                                                                                                                                                                                                                                                                                                                                                      1550 NEXT I
1560 PRINT
1570 FOR I = 7 TO 9
1580 PRINT BO(I);
                                                                                                                                                                                                                                                                                                                                                                                                               FOR I = 1 TO 9 REM THE FOLLOWING RIGAMARULE IS BECAUSE THE BASIC THE PROGRAM
360 KEM THE FOLLOWING RIGAMAROLE IS BECAUSE THE BASIC THE PROGRAM 390 KEM MAS WHITTEN ON DOES NOT ALLOW BOOLEAN OPERATORS: AND OR NOT, ETC. 400 IF BO(I) = A(J,I) THEN 440 410 IF A(J,I) >= 0 THEN 430 420 GC TO 400 430 IF BO(I) >-3 THEN 480 440 NEXT I 450 KEM END OF BOARD CHECK 460 IZ=J 470 GC TO 99
  440 NEXT 446 NEXT 446 NEXT 446 NEXT 446 NEXT 450 NEXT 500 FOR I = 1 TO 9
510 REM E IS AN ARRAY FOR TEMPORARY STORAGE WHILE ROTATING
510 REM E IS AN ARRAY FOR TE

520 E(I) = BO(I)

530 NEXT I

540 IF R > 4 THEN 670

550 REM FIRST HOTATE ONE WAY

560 BO(1) = E(3)

570 BO(2) = E(6)

580 BO(3) = E(9)

590 BO(4) = E(2)
  600 B0(5) = E(5)
610 B0(6) = E(6)
620 B0(7) = E(1)
630 B0(6) = E(4)
 030 B0(0) = E(1)

640 B0(9) = E(7)

650 GO TO 760

660 REM AND THEN THE OTHER

670 B0(1) = E(7)

680 B0(2) = E(4)

690 B0(3) = E(1)
  690 BO(3) = E(1)

700 BO(4) = E(8)

710 BO(5) = E(5)

720 BO(6) = E(2)

730 BO(7) = E(9)

740 BO(8) = E(6)
   750 BO(9) = E(3)
  750 BO(9) = E(3)
760 NEXT R
770 REM END OF ROTATIONS
780 REM NOW IT HAS BEEN ROTATED, DONE, NOT FOUND
790 REM CREATE A NEW BOARD
600 TH=T4+1
                                                                                                                                                                                                                                                                                                                                                                                                                  1970 IF BO(5) <> BO(9) THEM 1990
1980 IF BO(1) > -3 THEN 2010
1990 IF BO(3) <> BO(5) THEN 2010
2000 IF BO(5) = 50(7) THEN W = 8
2010 IF W = 0 THEN RETURN
2020 IF W = 1 THEN W = BO(1)
2030 IF W = 2 THEN W = BO(4)
2040 IF W = 3 THEN W = BO(1)
2050 IF W = 4 THEN W = BO(1)
2050 IF W = 5 THEN W = BO(2)
2070 IF W = 6 THEN W = BO(2)
2070 IF W = 6 THEN W = BO(1)
2080 IF W = 7 THEN W = BO(1)
2090 IF W = 8 THEN W = BO(1)
2090 IF W = 8 THEN W = BO(3)
2100 RETURN
600 T4=T4=1
810 P8=0
820 REM P8 IS USED FOR INITIALIZING THE # OF BEADS PER SQUARE
830 FOR 1 = 1 T0 9
840 ACT4, T) = BO(1)
850 IF BO(1) = -1 THEN P8=P8+1
860 NEXT I
870 IZ= T4
880 REM SEE TEXT ON INITIALIZATION OF BEADS
890 IF P8 = 1 THEN P8 = 3
910 IF P8 = 2 THEN P8 = 2
920 IF P8 = 3 THEN P8 = 2
920 IF P8 = 4 THEN P8 = 1
930 FOR I = 1 TO 9
                                                                                                                                                                                                                                                                                                                                                                                                                    2000 RETURN
2110 RETURN
2110 REM MACHINE WON.
2120 PRINT "I WON-BRAVO!"
2130 REM INCREMENT GAMES WON, ANDTOTAL PLAYED
  920 IF PO = 4 THEN PO = 1
930 FOR I = 1 TO 9
940 IF A(T4 | I) = -3 THEN A(T4 | I) = PO
950 NEXT I
950 REM THE FOLLOWING LINES COMPUTE THE WEIGHTED RANDOM SELECTION
970 REM OF BEADS. THERE ARE C1 TOTAL NUMBER OF BEADS. Q(C1) CONTAINS
960 REM THE EFFECTIVE COLOR OF THE BEAD (SQUARE NUMBER).
                                                                                                                                                                                                                                                                                                                                                                                                                     2140 G=G+1
2150 W1=W1+1
                                                                                                                                                                                                                                                                                                                                                                                                                    2150 W1=W1+1
2160 REM REFERENCED BY R2 AND INCREMENT IT
2170 FOR I = 1 TO R1
2180 A(R2(I,2), R2(I,1))=A(R2(I,2),R2(I,1))+1
2190 NEXT I
2200 REM GO PRINT OUT STATUS
970 REM OF BEADS. THERE ARE C1 TOTAL NUMBER OF BEADS. Q(C1) CONTAINS 980 REM THE EFFECTIVE COLOR OF THE BEAD (SQUARE NUMBER).

990 C1 = 0
1000 FOR I = 1 TO 9
1010 IF A(12,1) < 0 THEN 1050
1020 FOR J = 1 TO A(12,1)
1030 IF A(12,1) > 0 THEN C1=C1+1
1040 IF A(12,1) > 0 THEN Q(C1) = I
1050 NEXT J
1050 NEXT J
1060 NEXT J
1070 REM IF C1 IS ZERO THEN THERE ARE NO BEADS LEFT AND THE PROGRAM
1050 NEXT I
1070 REM IS GIVING UP.
1090 IF C1 = 0 THEN 2230
1000 REM R1 COUNTS THE MOVES MADE
1110 R1=R1+1
1120 REM G1 IS A RANDOM NUMBER BETWEEN O AND TOTAL NUMBER OF BEADS, C1
1130 G1 = INT((RND(Z)*C1))+1
1140 REM THEREFOR Q(G1) IS A WIEGHTED RANDOM SELECTION OF BEADS!
1150 REM M0 IS THE MOVE POSITION
1160 M0=Q(G1)
1170 BO(MO)= -1
1100 REM R2(MOVECOUNT, 1) GETS THE MOVE POSITION
1190 REM R2(MOVECOUNT, 2) GETS THE BOARD NUMBER SO IT CAN BE FOUND
1200 R2(R1,1)=M0
1210 R2(R1,2)=12
                                                                                                                                                                                                                                                                                                                                                                                                                     2210 GO TO 2360
                                                                                                                                                                                                                                                                                                                                                                                                                   2210 GO TO 2360
2220 REM DRAW SUBROUTINE
2230 PRINT "DRAW OR HESIGN"
2240 D=D+1
2250 REM PRINT STATUS AND ASK ABOUT GOING AGAIN
                                                                                                                                                                                                                                                                                                                                                                                                                     2260 G=G+1
2270 GOTO2360
                                                                                                                                                                                                                                                                                                                                                                                                                   2270 GOTO2360
2280 REM HUMAN WON SUBROUTINE
2290 PRINT "YOU WON-TURKEY"
2300 G=G+1
2310 L=L+1
2320 REM PUNISH MACHINE FOR LOSING
2330 FOR I = 1 TO R1
2340 A(R2(I,2),R2(I,1))=A(R2(I,2),R2(I,1))-1
                                                                                                                                                                                                                                                                                                                                                                                                                    2340 A(R2(1,2),R2(1,1))=A(R2(1,2),R2(1,1))=1
2350 NEXT 1
2360 PRINT " WON "; w1;" LOST "; L;" DRAW "; D;" TOTAL "; G
2370 PRINT "NEW GAME?"
2380 INPUT A$
2390 IP A$ = "Y" THEN 190
2410 STOP
2410 END
#
```

22 INTERFACE AGE

ANNOUNCING 051 6502 BK BASIC.

OSI's new 8K BASIC for the 6502 was written by Microsoft, the people who wrote ALTAIR® 8K BASIC for the 8080. OSI's 6502 8K BASIC is identical to this powerful and popular 8K BASIC with two very important exceptions: our OSI 6502 8K BASIC has automatic string space handling, and it runs faster. Up to 8 times faster than the 8080 BASIC. And hundreds of times faster than many 6800 BASICs.

In fact, the OSI Challenger with OSI 6502 8K BASIC can actually outperform most small- and medium-scale minicomputers, as well as every micro there is! And that includes the Z-80.

Perhaps even more amazing than its superlative performance is its surprisingly low price: either \$50 or free.

OSI 6502 8K BASIC is available to OSI System kit builders for \$50 on your choice of paper tape, audio cassette or floppy disk.

And OSI 6502 8K BASIC comes free with the purchase of any 12K or larger OSI Challenger.

So you can own a fully-assembled OSI Challenger complete with serial interface, 12K of RAM memory and our OSI 6502 8K BASIC for just \$807.

Incredible!

For more information, contact your local OSI dealer. Write OSI direct for our free OSI brochure. Or enclose \$1.00 for the full OSI catalog.

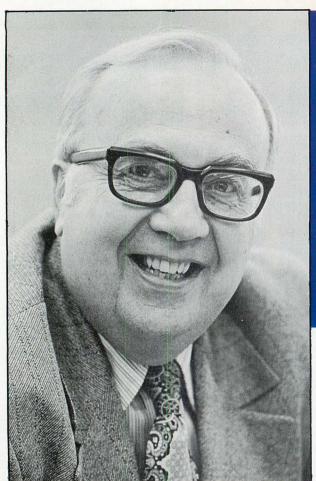
Once again, OSI offers more and costs you less.



OHIO SCIENTIFIC INSTRUMENTS

Dept. I

11679 Hayden Street, Hiram, Ohio 44234

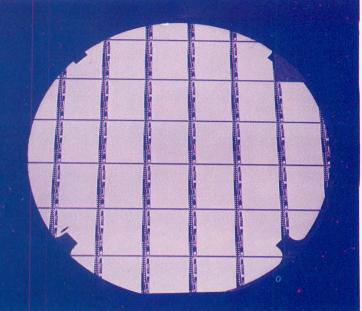


Dr. C. Lester Hogan

When the transistor was invented in 1948, it was hailed by the far-sighted at least throughout the engineering world as one of the greatest technical achievements of all time. Certainly this acclamation has proven to be justified; but in retrospect, one wonders what the impact would have been if we had gone no further than the point contact devices which were all we then had. A few months after this stunning announcement, however, Shockley published his theory of junction transistors. From our modern perspective, the semiconductor age had truly begun.

To many of us who have been involved in this field of endeavor for more than two decades, the decade that brought us from the first grown junction transistors to the I.C. technology which produces today's LSI circuits seems to have been a long and tortuous path with many blind alleys luring unwary individual researchers and companies into ultimately fruitless endeavors. But actually as we look at the record, we can take great pride in having been part of a strategic technical advance which occurred at unprecedented speed. From Kitty Hawk to our modern jet aircraft spanned forty years of exciting development. From the point contact transistor to today's I.C. technology barely 12 years were required.

The first grown junction transistor was built in 1951 and the first microprocessor in 1970. Less than twenty years elapsed between man's first crude efforts to build a junction transistor and his



Typical wafer fabrication showing die layout

Reflections on The Future of

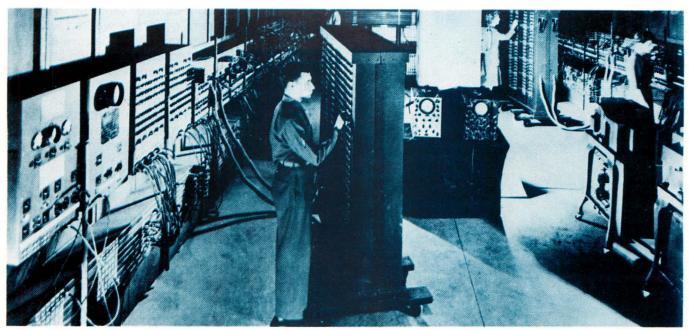
first device which made a complete digital computer truly a "component" of electronic systems.

This 20-year era neatly divides itself into two ten-year periods which were significantly different periods as we shall soon relate. During the first decade after the invention of the transistor, a multitude of techniques were proposed for achieving both transistors and integrated circuits. While in general each proposal was superior to what had gone before, each in its own way fell prey to the onward rush of ever newer technology.

Then in 1959, the Planar process was born and Bob Noyce added the significant achievement of aluminum metalization over the oxide and since that time, no really new processes have arisen. Today's most advanced devices still use the approach proposed by Noyce 18 years ago.

This is a remarkable timetable in comparison with any other technical achievement. When viewed from this perspective, the road does not appear to have been long and tortuous, but instead short and direct.

To me, one of the most startling aspects of this history was the very early date at which many researchers were thinking about integrated circuits. As early as 1953, Harwick Johnson¹ of RCA conceived of a complete phase shift oscillator built in a single chip of N-type germanium where p-n junctions supplied the necessary capacitance, the body resistance of the piece of germanium supplied the resistive elements and an alloy transistor at one end of the filamentary piece of germanium



Eniac, the world's first electronic digital computer.

the Past and Thoughts About Semiconductor Technology

By Dr. C. Lester Hogan

supplied the necessary amplification. Johnson's pioneering achievement is illustrated in Figure 1 (See page 26).

It is obvious that we wouldn't have gone very far toward today's devices if we were constrained to the use of alloy transistors. In fact, it was this realization that accounted for the fact that this approach was not exploited in the late 1950's. However, the diffused base transistor did not become a reality until 1955 and in 1953 there was little technology available for Johnson from which to choose except the grown junction and the alloy junction transistor. In fact, in one version of his invention, he included both a grown junction and several alloy junctions to achieve his primitive integrated circuit.

The significant point is that only two years after the first junction transistor was reported, research people were already trying to combine resistors, capacitors, and transistors onto one piece of semiconductor material in order to reduce size, to reduce number of interconnects and to improve reliability. The work of Johnson was well known to workers in the field at that time, and I believe historians of our art have not given enough credit to him for his foresight and pioneering achievements at such an early date.

Apparently not so well known was that fact that

Sydney Darlington² proposed as early as May 1952 a technique for constructing a complete Darlington amplifier in one piece of semiconducting material using grown junction transistors. A somewhat similar device was patented by B.M. Oliver³ also in 1953. Barney Oliver's reduction to practice is illustrated in Figure 2 (See page 26).

Other than these pioneering approaches, the nearest anyone seems to have come to conceiving today's integrated circuits was G.W.A. Dummer4 at the Royal Radar Establishment who described his work at an International Symposium on Electronic Components at Malvern, England, in mid-1957. At this meeting Dummer described "a transistor flip-flop with two emitter follower outputs a total of four transistors all contained in a chip of silicon 125 mils by 375 mils. The semiconductor was doped to form a p-n-p structure and had various sections removed to leave thin bridges of material with relatively high resistances. These high-resistance paths formed the collector and emitter loads of the transistors connected to common power supply rails. Other resistors were provided by films of resistive material deposited on the surface of the silicon, while capacitors were constructed from thin metallic layers with insulators between."

²United States Patent No. 2,663,806 issued Dec. 22, 1953; application May 9, 1952.

³United States Patent No. 2,663,830 issued Dec. 22, 1953; application Oct. 22, 1952.

¹U.S. Patent No. 2,816,228, issued Dec. 10, 1957; application May 21, 1953.

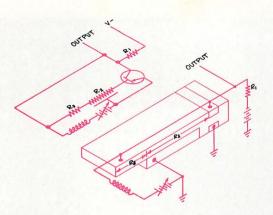


Figure 1.

Harwick Johnson's pioneering work in integrated circuits is illustrated above. This figure is taken from a patent application of May 1953 and to the best knowledge of the author this represents the first effort to integrate resistors, capacitors, and transistors into one piece of semiconducting material.

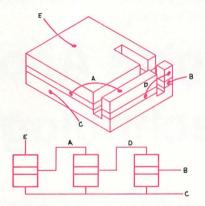


Figure 2.

Along with the work of Sydney Darlington, this integrated circuit suggested by Barney Oliver in 1952, represents the very earliest attempt known to the author to integrate several transistors on one chip of germanium or silicon. This reduction to practice included no passive components, and hence, was not as advanced as the work of Harwick Johnson illustrated in Figure 1. However, it predates Johnson's work by one year.

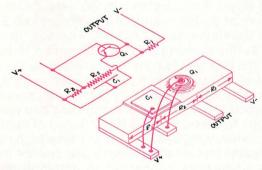


Figure 3.

Drawings taken from the patent of Jack Kilby which was filed on February 6, 1959. The similarity of approach to the work of Harwick Johnson is obvious if one compares this figure to figure 1, which illustrates the work of Johnson six years before. Of course, the above reduction to practice includes two diffused junctions and one alloyed junction, while the work of Johnson used alloyed (and in one case grown) junctions.

In most of the work done or reported in 1957 or 1958, the researchers generally worked with germanium mesa transistors since they were in production and represented the state of the art during that time frame. In February 1958⁵ the Diamond Ordnance Fuze Laboratory described an attempt to evaporate aluminum interconnects on top of mesa transistors leaving a layer of photoresist on top of the germanium mesa transistor in order to supply the insulating layer between the germanium and aluminum.

Even though this contribution by DOFL was significant in the mid-1950's and superficially it appears that they came close to the structure which actually made the integrated circuits a reality, they basically were taking the wrong approach. A closer look at their philosophies and techniques demonstrates clearly that their approach was one of the earliest demonstrations of what we refer to today as a hybrid circuit. They began with a steatite ceramic base 1/2" x1/2" which was 20 mils thick. Conductive wiring was screened on and fired. Then resistors were screened on and fired. The germanium transistors were glued into holes in the ceramic by use of epoxy or wax, a layer of photoresist was placed over the mesa transistor and the interconnect to the ceramic was then achieved by evaporated aluminum.

In any event, by January 1958, almost all semiconductor research laboratories were trying to find a way to reduce to practice the exciting potential of integrated circuits. The idea of connecting resistors, capacitors, diodes, and transistors together on a single chip of germanium or silicon was not a new idea by that time. The only problem was to find a technique that would really work.

All of the above schemes (except the clever approach of DOFL) used wire interconnects soldered, welded, or thermocompression bonded on the chips to connect together certain of the elements. For example, in August 1959, Jack Kilby⁷ described a multivibrator built in a chip of germanium. It contained two germanium mesa transistors, two distributed RC networks nearly identical to the networks described in the patent of H. Johnson. except the junction was diffused instead of being alloyed. In addition, there were six resistors formed by the body resistance of the germanium chip itself. The chip was 240 mils by 250 mils and required six gold wires to interconnect the various components on the chip. In the patent⁸ issued to Kilby in June 1964, he describes both this multivibrator and a phase shift oscillator. The oscillator is illustrated in Figure 3. The oscillator is again

26 INTERFACE AGE MARCH 1977

^{4&}quot;Solid Circuits" Wireless World, Nov. 1957, page 516 (quotation Marks above constitute exact wording of this article.)

^{5&}quot;Army Develops Printed Transistors", Control Engineering, February 1958, page 31.

The DOFL Microelectronics Program, *Proceedings of the IRE*, May 1959, pp882-894.

^{&#}x27;Semiconductor Solid Circuits, *Electronics*, Aug. 7, 1959, page 110.

⁸U.S. Patent No. 3,183,743 issued June 23, 1964; (application February 6, 1959.)

nearly identical to the device described by Johnson in his application of 1953 except that two of the junctions are diffused mesa junctions instead of being alloyed junctions. The emitter junction is, of course, alloyed because that was the state of the art at that time. These illustrations along with the description of work above being done at the Royal Research Establishment in 1957 and the work at DOFL in 1958 demonstrates clearly that many laboratories across the world were attempting to find techniques to build integrated circuits.

This achievement led many people active in solid-state device research to believe that other molecular devices broadly analogous to the maser would be invented and that the future lay in this direction rather than in the direction of attempting to build individual components all interconnected in a single block of silicon or germanium.

These examples do not constitute a complete review of all the efforts during the late 1950's by various laboratories to achieve a workable integrated circuit. The author is familiar with other aborted attempts to wire bond many transistors on a single substrate and even other work which used epoxy resins, silicone compounds, and even evaporated silicon monoxide to form the insulating and passivating layer that would then permit evaporated metal interconnects. Almost all of this work was done on germanium mesa transistors, of course. None of these approaches worked and none is being used in today's integrated circuits.

In this avid search for monolithic blocks of material that performed complete circuit functions, yet another approach became quite popular. At this same time the first masers and lasers were being demonstrated and they were operating both as oscillators (stimulated emission of radiation) and as amplifiers.

These oscillators and amplifiers made use of the atomic and molecular characteristics of the body of the material and there were no discernible components i.e., resistors, capacitors, inductors, transistors or diodes within the so-called circuits. This achievement led many people active in solidstate device research to believe that other molecular devices broadly analogous to the maser would be invented and that the future lay in this direction rather than in the direction of attempting to build individual components all interconnected in a single block of silicon or germanium. A word was even coined for this approach. It was referred to as molecular electronics, to distinguish it from the active field of microelectronics, or integrated circuits as it came to be called.

Microwave amplifiers and oscillators other than the maser had already moved somewhat in this direction. While it was certainly possible to draw an equivalent circuit of a travelling wave tube if



CIRCLE INQUIRY NO. 22



CIRCLE INQUIRY NO. 12

one cared to do so, actually such an amplifier (or oscillator) depended upon the interaction of an electron beam with an electromagnetic wave whose propagation characteristics were determined by properties of a geometric structure. In one sense, these microwave circuits were the forerunner of what many researchers believed would come to pass for many circuits.

In April of 1957⁹, Ed Herold of RCA was quoted as saying, "The chemical synthesis of an improved compound, the technology of its use, and/or the discovery of a new useful effect in these materials can now do more to revolutionize the performance of an electric circuit than can all the classic ingenuity of the circuit designer. The trend toward merging of circuit and device, which started with microwave tubes, is now found in more and more applications at all frequencies." In 1957, the author agreed whole heartedly with this point of view.

"pioneering stages" . . . "not capable of production".

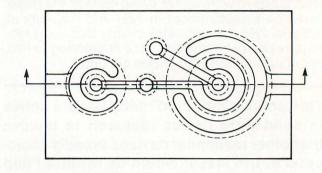
In light of today's technology, it was probably a little optimistic, but for the younger readers who did not live through this era, this point of view reached its height in the flush of the great achievements of the maser and laser. These strides had followed with relative speed after the achievement of building a new circuit element, the microwave gyrator¹⁰ (and circulator) using the bulk properties of the new ferrite materials. In addition, computer memory had been mastered by these new ferrite materials and many research workers were hard at work building complete computers (logic and memory) out of nothing but ferrite cores and copper wire.

A good feel for the atmosphere of these times is illustrated by reading articles that appeared in *Business Week* in 1959.¹¹

Thus we see that the search for the integrated circuit was a multifaceted approach. Everyone believed in its future but everyone was familiar with the attempts to build integrated circuits by H. Johnson at R.C.A., G.W.A. Dummer at the Royal Radar Establishment and others and it appeared to most serious workers at that time that all these attempts were in words of G.W.A. Dummer ¹² "pioneering stages"..."not capable of production".

It was in this atmosphere that John Hoerni¹³ developed the planar process and Bob Noyce ¹⁴

extended it to the integrated circuit structure and process that are basic to LSI circuits. Bob Noyce's reduction to practice is illustrated in Figure 4. Just one glance at that figure tells more than a thousand words. All the basic elements of todays LSI circuits are contained in this one invention.





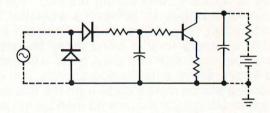


Figure 4.

The approach to integrated circuits proposed by Bob Noyce in a patent filed July 30, 1959. The "quantum jump" proposed by Bob Noyce over all other previous approaches is obvious by comparing this figure with figures 1, 2 and 3 which illustrate some of the approaches suggested by others in the period between 1952 and 1959. More than this, however, is the point that this is the technique that finally worked and is the technique in use today to make all integrated circuits possible.

The author remembers well the day he learned about Hoerni's and Noyce's inventions. In August of 1959 after the Wescon Show, C. Harry Knowles who was then working for the author at Motorola (Phoenix, Arizona) visited Fairchild Semiconductor because they were recruiting him. In order to attract him to their operation they showed him the properties of the early planar devices including devices with metal over the oxide and discussed their concept of the integrated circuit which was basically the concept disclosed in the Noyce patent #2,981,877. Upon returning to Phoenix in early September 1959. Dr. Knowles discussed all these processes with us and as a result we immediately organized a team to exploit the planar process and the Noyce concept of the integrated circuit.

There was immediate recognition that this process solved all of the difficulties encountered with

28 INTERFACE AGE MARCH 1977

^oSolid State Research Brews Upheaval, *Aviation Week*, April 8, 1957, page 86.

¹⁰C. L. Hogan, Bell System Tech. J. 131 (1952).

¹¹ Business Week, April 4, 1959, p. 130; July 25, 1959, p. 34.

¹²IC. Inventors, Letter to the Editor, *IEEE Spectrum* by G.W.A. Dummer Dec. 1976 page 22.

¹³U.S. Patent No. 3,025,589 issued March 20, 1962 (John Hoerni) filed May 1, 1959.

¹⁴U.S. Patent No. 2,981,877 (R.N. Noyce) issued April 25, 1961 filed July 30, 1959.

every other approach to integrated circuits at that time. This was indeed the quantum leap we had been trying to find and the author's judgment today remains exactly as he formed it in September 1959. This was beautifully expressed by G.W.A. Dummer, in a very recent note¹⁵... "I would have no hesitation in saying that . . . the real inventors of integrated circuits are Noyce and his dedicated team at Fairchild."

The planar process introduced in 1959 had become the pillar of the entire industry since that time. It is this process which made possible first, the era of integrated circuits, and then, the era of LSI which is so dramatically illustrated by the microprocessor.

The course of development from the first junction transistor to the first planar transistor is more complex and yet more twisted than the story related above. In the first place enormous effort was extended which resulted necessary and important breakthroughs made in the chemistry and metallurgy of semiconducting materials. First these materials (in particular germanium and silicon) had to be prepared with a purity level never before achieved by man. Then these materials which melt at relatively high temperatures (900 °C-1400 °C), had to be grown as large single crystals. Finally techniques of controlled doping of these extremely pure, extremely perfect single crystals had to be developed in order to build the required N and P type regions with the required geometry.

These were not simple problems. Their solution required tremendous investment of time and money. But more than this, the solution to these early problems required tremendous inspiration and genius on the part of the hundreds of individual research workers who made the necessary breakthroughs.

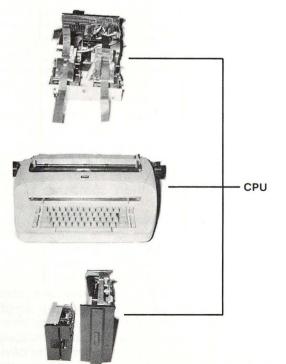
It is probable that no laboratory in the world other than the Bell Telephone Laboratories had both the resources of qualified men and the allocatable funds required to make the initial technological breakthroughs. They did extend the necessary effort and one by one the major technological hurdles were left behind. Then, in one of the most public spirited actions in the history of our private enterprise system, they shared this technology with the rest of the world through papers presented at technical meetings, through extensive publication of the results of this massive research and development program, through technical seminars held at the Bell Telephone Laboratories and through a rather generous patent licensing procedure. There can be no doubt that the semiconductor industry would not be where it is today without these great contributions from this enormously valuable national resource. The Bell Telephone Laboratories.

By the time the planar transistor was developed, however, the technologies developed at Bell Labs were widely disseminated throughout the world. These technologies included zone refining, crystal growing, diffusion techniques, thermocompression

15 op cit.

FOR REAL RELIABILITY...at lowest cost

Get the first really effective Selectric® conversion kit. Not a mechanical nightmare or a collection of switches and coils, this unit is designed around specially built solenoids and the latest opto-electronics to achieve a superior product. This product gives you the usage of the same rugged mechanism that has been the industry standard.



same rug	gged mechanism that has been the indust	try sta	ndard.
Item	Description		Price
SK-1	Selectric conversion kit, with all mechanicand electronic parts. Needs 1 amp at 12 vol		118.00
SK-2	SK-1 with built-in power supply and TT compatibility	L	168.00
SK-3	SK-2 with controller kit giving RS232 serion ASCII data at 110 or 300 BPS. A high spee paper tape interface is included		389.00
DK-1	Floppy disk and controller kit, with 350 K drive. For use with SK-3, or any seri- interface, up to 19200 BPS. Contains hig level DOS, with simple commands makin any terminal a smart one or any serial CPU disk system	al h	795.00
	from above kits are offered for the purpose of nds for manuals apply on subsequent kit orde		ting the
SK-D1	Selectric Conversion Manual		6.50
SK-D2	Selectric Programming Manual, with listings and timing data		6.50
DK-D1	Floppy Disk Kit & DOS Manual		6.50
	s acknowledged within 24 hours with firm shippi is required on COD. Send check or MO to		e. A 50%

Sharp & Associates
Box 26045, Lakewood, Colorado 80226

bonding, evaporated aluminum contacts, oxide masking in silicon structures, but—peculiarly—not the retention of the oxide on the device as in

the planar process.

For the next several years many different approaches for building transistors and integrated circuits were explored. The first junction field effect transistor was demonstrated in 1952, the surface barrier transistor in 1953, the micro-alloy transistor in 1954, the diffused base germanium and silicon transistors in 1955, the micro-alloy diffused transistor in 1956, the grown diffused transistor in 1956, the PNPN transistor in 1956, and the planar transistor in 1959.

These various approaches were exploited or ignored by various companies according to their technical histories, momenta, and managerial outlooks. Two that have passed from the scene but were important in establishing a large share of market for different companies were the microalloy diffused transistor and the germanium mesa.

The micro-alloy diffused germanium transistor was exploited by Philco Corporation in the mid 1950's and its superiority in performance over other transistors of that time made Philco by 1958 one of the top three semiconductor manufacturers. This structure was first made obsolete by the germanium mesa (diffused base) transistor which became available in production quantities in 1958 and then by the silicon planar transistor which became available in production quantities in 1960. The germanium mesa was most successfully exploited by Motorola and Texas Instruments and this successful exploitation helped establish Motorola as an important supplier of semiconductor devices and was by 1963 or 1964 a contributing factor toward establishing that company as the second largest semiconductor manufacturer in the United States.

Obviously in 1953 any projection of the next twenty years of integrated circuit technology based on Harwick Johnson's alloyed junctions would have fallen far short of what was actually achieved because this was not the process that was used to realize today's circuits.

Even this summary is not complete and it cannot be made so without making this article too long. Perhaps, however, we should mention the so-called push-out base or post alloy diffused transistor which was brilliantly exploited by Philips in Holland in the late 1950's and early 1960's. This was similar to the micro-alloy diffused transistor but the technique of manufacture was completely different from the approach used by Philco; and perhaps because of this, it had a much longer useful life in our industry. (In reality it was a hybrid between the micro-alloy and mesa device.)

After this decade of new techniques tumbling out of the laboratory each year the planar process

appeared on the scene and it still reigns as the only viable process for mass production of general purpose components and circuits.

Certainly one advancement was the invention of the MOS transistor in 1960. This transistor was not conceivable using the other processes but once the planar process with metal over oxide became available then the MOS transistor was an obvious, but important, development.

Before the advent of the planar process, projections of future directions were in one sense meaningless because the process used to build devices changed on a yearly basis.

The first junction transistor was as we related above, a grown junction transistor and until the alloy transistor was developed in 1952, this was the only way one could make junctions. As a result the first chips that combined several transistors on the same chip (ala Darlington & Oliver) used grown junctions. Obviously in 1953 any projection of the next twenty years of integrated circuit technology based on Harwick Johnson's alloyed junc-

tions would have fallen far short of what was

actually achieved because this was not the process

that was used to realize today's circuits.

As Moore's law it has been an extremely accurate projection of the industry's capability for the past ten years. This law predicted that ten years later i.e., in 1975 integrated circuit chips would be available with a thousand times as many (actually 1024) elements on them as existed in 1965.

The relative stability of the basic process for the past 17 years has allowed the industry to make meaningful projections of the future during the past 15 years. One of the earliest projections with which the author is familiar was one made by Harry Knowles at the "Modular Magic Panel" at the IEEE Show on March 25, 1964. At that panel Harry Knowles predicted that perhaps in a decade the industry would put one million component elements per square inch on a silicon "chip" with all required interconnects. This was not a bad estimate when one realizes at that time the industry had achieved a density of approximately 6000 components per square inch. The most complex chips available at the market place in 1976 had a density of approximately one million components per square inch.

The largest chips available with reasonable yield are approximately 200 mils on a side but one attempts to make chips smaller than this because today the yield and cost are directly related to chip size. During 1976 the state of the art in chips that were available for sale was well demonstrated in the 16,000 bit N-channel MOS RAM chip which contained approximately 40,000 components interconnected on a chip whose area was approximately 35,000 square mils. This chip has a density of devices slightly higher than the million components

MERCIA

The Intelligent Video Interface

standard nonposite video for signal are available separately on the connector, the

Circuitry — 160 H x 100V resolution

Super Dense Graphics Kit increases MERLIN's resolution to 320H x 200V. This board plugs directly into MERLIN at the test and expansion socket (M320 — \$39).

200 Page, 3-ring User Manual tells how MERLIN works tells how to use it (\$10).

KYBD & Serial I/O Port

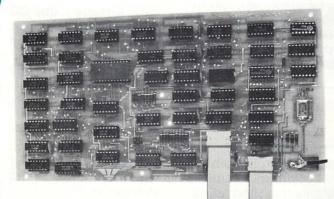
KYBD & Serial I/O Port

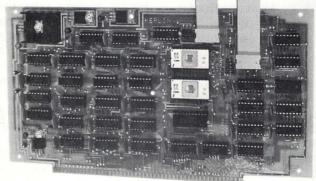
for keyboard,
has 8 bit parallel input for keyboacks
has 8 bit parallel input for keyboacks
has 8 bit parallel input for serial expansion.

for serial expansion.

MEI 2K x 8 Mask ROM

Extended Monitor & Editor functions plus graphics and cassette subroutines (\$34.95)





S-100 Bus Compatible

ROM Character Generator for ASCII Display mode 40 characters by 20 lines

16 Bit Scroll Register

DMA Circuitry

Display any portion of your system memory.

Serial Expansion Kit provides
Serial

8-Bit Programmable Mode Register

8-Bit Programmable ASCII, graphics
Program MERLIN for ASCII, graphics
Program Mercial display formats.

Software Tarbell Compatible Cassette Interface

Interfaces via keyboard cable. Software is available in the MEI ROM (MCAS — \$29).

MBI 2K x 8 Mask ROM System Monitor and Editor plus scrolling and I/O drivers.

MBI ROM/RAM
(Eliminates need for expensive

Monitor Boards.)

The MERLIN Kit with manual is \$269.

MERLIN assembled & tested is \$349.

Order yours today.

MC and BAC accepted

If you are still not convinced that MERLIN is the best buy in Video Interfaces/Monitors see one at your local computer store or write for more info.



Box 268, Bedford, MA 01730 (617) 648-1200

per sqaure inch predicted in 1964 by Harry Knowles.

However, density of components on a chip is not the only factor that permits complexity in an LSI chip. The other factor is size of chip which the industry can make at reasonable yields. Over the years, both density and chip size have increased. Any proper projection of the levels of integration that can be achieved on a single chip must take both factors into account. Actually, Harry Knowles did this in his 1964 projection. At that time he predicted that one decade later we would actually have single chips one inch square and hence single LSI chips would contain one million elements all interconnected. He recognized that it would be nearly impossible to achieve such chip sizes and densities using the photolithographic techniques common to the industry. So, in what seems to the author as brilliant foresight, he predicted that in 1974 we would be making these chips using electron beam lithography. Actually these forecasts were a little optimistic, but perhaps not in nature but only in the particular timing.

Obviously, nothing can double every year for ever.

The most precise early projections of potential integrated circuit complexity known to the author were those made by Gordon Moore in a short article in Electronics Magazine in 1965. Dr. Moore included both increased density and increased chip size and predicted that the complexity available in monolithic integrated circuit chips would double every year for the next ten year. This has since come to be known in the industry as Moore's law and it has been an extremely accurate projection of the industry's capability for the past ten years. This law predicted that ten years later i.e., in 1975 integrated circuit chips would be available with a thousand times as many (actually 1024) elements on them as existed in 1965. One can appreciate the extent of Dr. Moore's projection when he realizes that in 1965 the best integrated circuits had between 20 and 40 elements interconnected on the one chip. And indeed, in 1975 chips were available with approximately one thousand times this complexity.

In December 1975 at the International Electron Device Meeting in Washington, D.C. Dr. Moore¹⁶ extended his law for the next ten years by saying that beginning in 1980 the complexity of monolithic integrated circuit chips would increase at half the rate (i.e. double every two years) which it did during the previous 15 years. Obviously, nothing can double every year for ever. If it did, then the number of elements on a single integrated circuit chip would eventually, about 254 years, exceed the number of electrons in the known universe. Such a projection is obviously impossible. So Gordon Moore's law eventually has to be modified in the

direction in which he did modify it in 1975. The author believes Dr. Moore has been very astute for maintaining the old slope for at least five more years.

The first of these is the advent of CCD technology. Already today CCD imaging chips are available with 160,000 picture elements on a single chip.

There are several factors which the author believes will keep the industry on the old slope for approximately five more years before we must

drop to the reduced slope.

The first of these is the advent of CCD technology. Already today CCD imaging chips are available with 160,000 picture elements on a single chip. These chips will soon be available as memory chips with the same number of elements. But even more exciting than this, the author believes is the present availability of electron beam mask making equipment which Harry Knowles predicted would be available some thirteen years ago. Today, optical limitations make it very difficult to make high resolution masks in which individual chips are larger than 1/2" on a side. The present electron beam machines can easily make masks for chips as large as one inch on a side and there seems to be no reason why this cannot be substantially increased in a few years. In addition the present electron beam machines can make masks with 1/2 micron geometry so certainly some increase in density will come as a result of the use of the machine. However, the greatest improvement at present appears to be in the chip sizes which the machine will facilitate in the next few years.

While many laboratories have worked on electron beam lithography the first and best machine appears to be the one that was operating at Bell Telephone laboratories more than three years ago. Here again in another public spirited move, the Bell Labs made this machine available to American industry by selling the complete technology package. As a result, the machine is now available and the first devices made possible by the use of this machine outside the Bell System will be at the market place some time in 1977. It does not seem unreasonable to the present author to project that in 1980 devices approaching a complexity of two million interconnected components will be available as a result of this new technique in mask making. This would indeed keep the industry on the slope of

Moore's law until that time.

The progress of the past decade is well illustrated in figures 5, 6 and 7. Figure 5 shows a complete wafer from the time period of 1966-1967. The wafer itself is 11/2" in diameter. The individual die has an area of approximately 9000 square mils, which by the way fits exactly on Moore's law for 1967. The increase in wafer size, die size and component density are obvious by comparing this with figure 6 which shows a digital watch circuit being manufactured by the Exetron Division of Fairchild in 1976.

32 INTERFACE AGE **MARCH 1977**

¹⁶Progress in Digital Electronics, Gordon E. Moore paper 1.3 Proceedings of the Int'l Electron Device Meeting, 12/75.

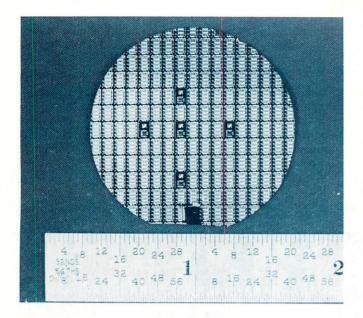


Figure 5.

This illustration shows a typical integrated circuit wafer from the production lines at Fairchild in the time frame of late 1966 to early 1967. The wafer is $1\frac{1}{2}$ " in diameter. The individual dice one of the wafer have an area slightly in excess of 9000 square mils. The geometry of the structure is composed of lines (and spacings) which are approximately $\frac{1}{2}$ mil (\approx 12 μ).

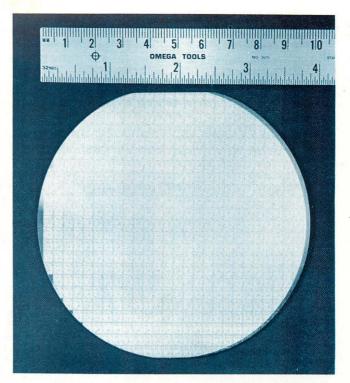


Figure 6.

Illustration of a digital watch circuit being manufactured by the Exetron Division of Fairchild in 1976. The wafer is 4'' in diameter, the individual dice are 24,300 square mils, and the line widths approximately 5 μ .

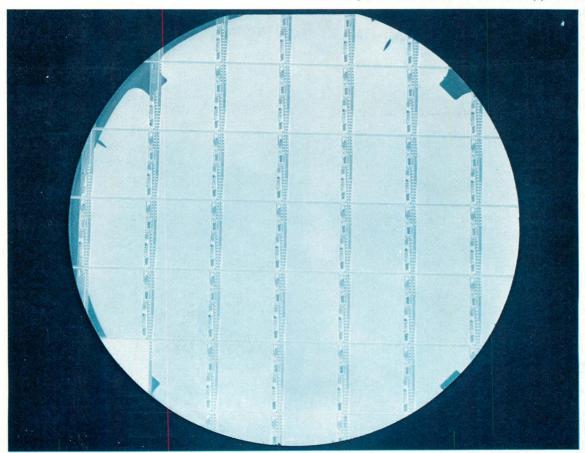


Figure 7. Illustration of a CCD imaging chip being manufactured by Fairchild in 1976. The individual die is close to the state of the art at that time. The wafer above is 3" in diameter, the individual dice have an area in excess of 200,000 square mils. The device is made with a minimum geometry of 4μ and contains 180,000 picture elements plus 180,000 shifting electrodes plus some simple overhead circuitry. This equates to nearly 370,000 individual components on the die.

The wafer has a 4" diameter, the die has an area of approximately 25,000 square mils and it uses a minimum geometry of approximately 5 to achieve the density illustrated. This die falls slightly below the complexity indicated by Moore's law for 1976 but the CCD die shown in figure 7 falls slightly above the prediction of Moore's law for 1976 complexity.

One gets a greater appreciation for the progress of electronic technology over the past 30 years if

one compares one of today's microcomputers with the world's first all electronic digital computer the Eniac. A full realization of what has happened is evident by comparing figure 8 which is only a part of the back panel wiring of the Eniac with figure 9 which is a complete F-8 microcomputer including a total of 1500 bits of RAM. (The F-8 has 512 bits of RAM on chip and the figure illustrates a configuration with 1K bits outboarded.) The block diagram indicating what is on the printed circuit board of figure 9 is shown in figure 10.

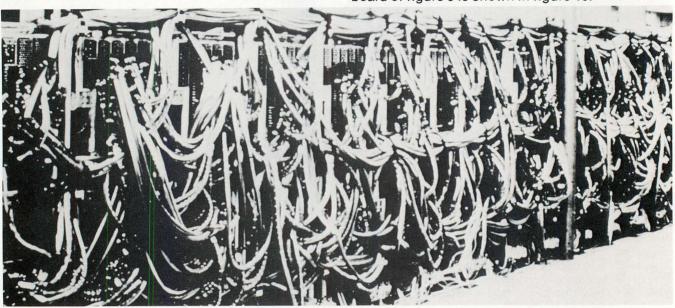


Figure 8.

Part of the back panel wiring for ENIAC.

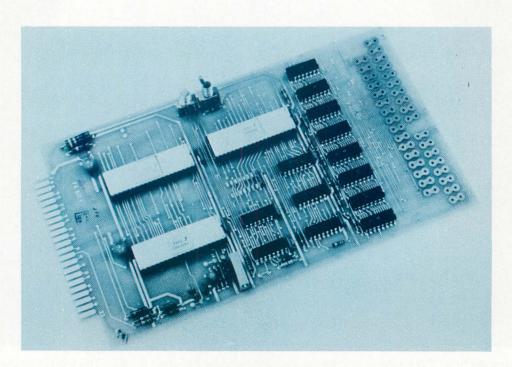


Figure 9. F-8 microcomputer board containing CPU, PSU (program storage unit) Static memory interface, a 1K RAM package, and T^2L logic to interface with a teletypewriter. This is a complete microcomputer except for power supply and occupies one printed circuit board $5'' \times 8''$.

34 INTERFACE AGE MARCH 1977

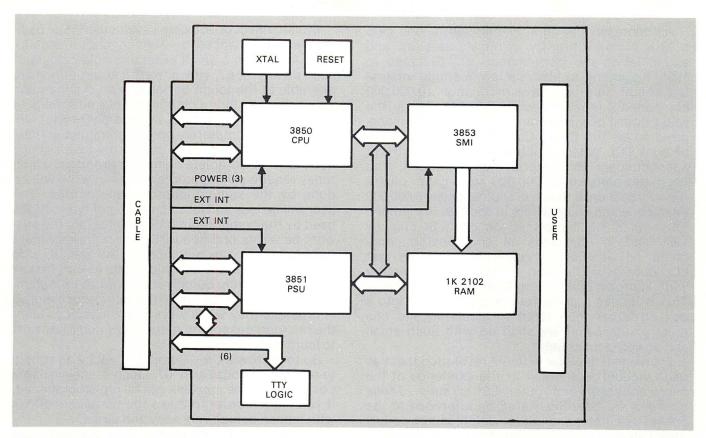


Figure 10. Block diagram of microcomputer shown in Figure 9. The board in Figure 9 has eight 2102's giving the microcomputer 8704 bits of RAM.

The comparison between these two electronic digital computers is detailed in Table 1.

\mathbf{T}	AI	\neg		
- 1	ΔІ	≺ I	_	

ITEM	PARAMETER	ENIAC	F8*	COMMENTS
1	Size	3,000 cu. ft.	.011 cu. ft.	300,000 times smaller
2	Power consumption	140 kW	2.5W	56,000 times less power
3	ROM	16K bits (relays and switches)	16K bits	Equal amount
4	RAM	1K bits (flip- flop accu- mulators	2.5K bits	2.5 times more RAM in F8
5	Clock rate	100 kHz	2 MHz	20 times faster clock rate with F8

6	Transistors or tubes	18,000 tubes	20,000 tran- sistors	
7	Resistors	70,000	None	F8 uses active devices as resistors
8	Capacitors	10,000	2	5,000 times less
9	Relays and switches	7,500	None	
10	Add Time	200 μ sec (12 digits)	150 μ sec (8 digits)	About the same
11	Mean time to failure	Hours	Years	More than 10,000 times as reliable
12	Weight	30 tons	1 lb.	

^{*}For comparison in this table the F-8 microcomputer is assumed to consist of one 3850-CPU, one 3856-PSU (2K bytes of ROM), one 2K RAM package, and the static memory interface chip 3853, plus the TTY interface circuitry illustrated.

As impressive as this comparison is, one gets a view of the future by using Moore's law and extrapolating the performance of LSI chips to 1985. According to Moore's law, a single integrated circuit chip will have more than 10,000,000 components interconnected by 1985. Today the world's most powerful computer is generally recognized to be the Cray-I Computer, which is built of dual ECL gates which have a complexity of approximately 30 components per circuit. The computer consists of 200,000 such gates plus a memory section. It thus has approximately 6,000,000 interconnected components in addition to memory. This will easily be placed on one LSI chip by 1985 and, if one adds 14 additional memory chips, he will have a computer nearly as fast but more powerful than today's Cray Computer with approximately 65 million bits of memory. This is indeed a powerful computer to put into a box no larger than today's calculator, and one must ponder what we shall do with such small and powerful machines!

Everyone is familiar with the revolution that has been created as a result of the existence of the microprocessor and other LSI circuits. These changes are best illustrated by reference to the pocket calculator and digital watch, but obviously they extend into everything that is touched by

electronic systems.

The applications are legion and have been covered by many others in literature. They, of course, include electronically controlled automobile systems, point of sale systems, video games, intelligent terminals, complex traffic light controls, controls for household appliances and so forth. But perhaps more important than the listening of the various applications is what these devices have done to engineering in general.

Ten years ago, if one set about to design the electronic system for an adaptive traffic light controller with walk signs and left turn lanes, he began by establishing the exact specification of the system. Then, as a minimum, he went to the drawing board and began the logic design of this rather complex system. Ten years before that, he started with transistors and individual components and even did the basic circuit design in order to achieve the logical functions he needed.

Now both circuit design and logic design have been virtually eliminated from the electronic systems engineers day-by-day tasks. He starts with a microprocessor and the basic problem is to write a program for the microprocessor so that it will control the particular system in exactly the way the engineer wants it controlled. Beyond this then, he must add the sensors and actuators and the necessary convertors. This particular part of the task has not benefited as much from the LSI revolution as have the memory and logic parts of his system. Obviously this is a field that offers exciting frontiers for the next several years. Though difficult these fields too will eventually yield to advancing semiconductor technology. Perhaps electromechanical technology will only survive in the area of human interface with the system.

Even the field of software development has been irretrievably changed by semiconductor technology. Already in a small programmable calculator such as the HP-67, very powerful sub-routines are available at the touch of one button. As the complexity of the silicon chip increases and the cost of producing it decreases, evermore powerful routines will be completely pre-programmed in ROM and made available to the user at the touch of one button. Thus, complete computer programs which today require skilled programmers to write will be done by the semiconductor manufacturer. The user will be less and less conscious of the routines used by the computer in order to give him the answers he wants and needs. Software development then becomes the province of the people who manufacture the silicon chips. It turns out, that as humans have very quickly mastered the programmable calculator and now the microprocessor, it is probable they will always find it easier to learn the microprocessor, no matter how complex, than to learn pure software.

So tomorrow's Cray Computer will be as simple to program as today's HP-67. Much of the available complexity of the machine will be pre-programmed, if you like, in order to make the communications with human beings very easy and direct.

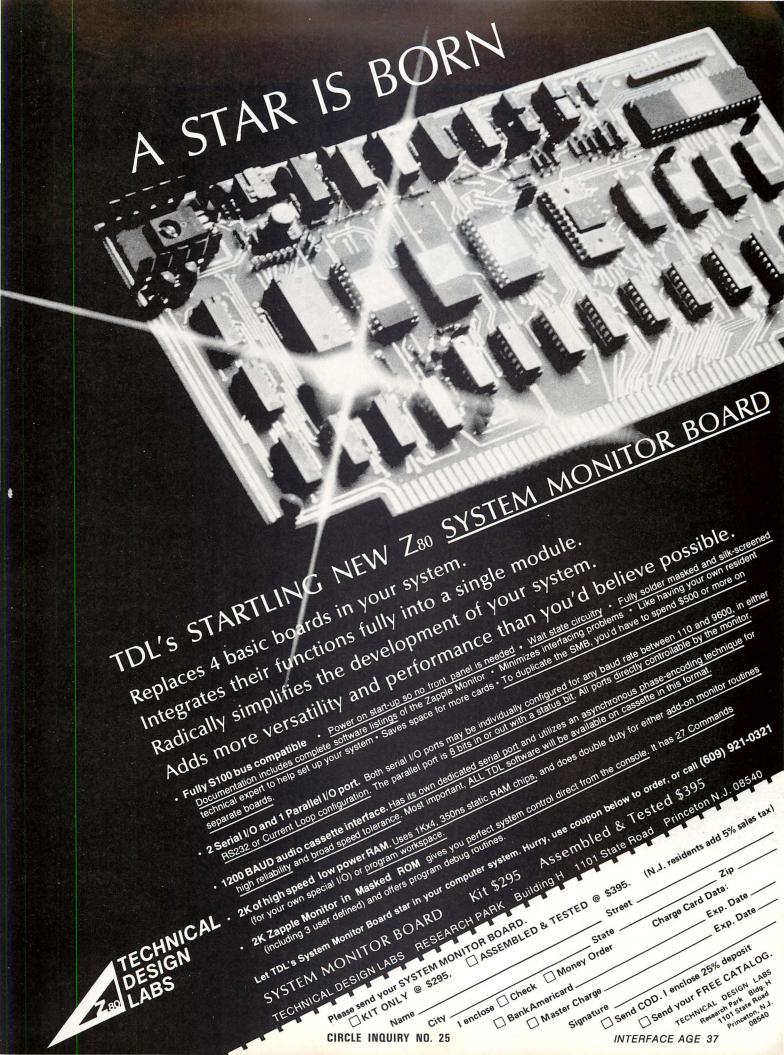
Today, the semiconductor manufacturer has taken logic design away from the systems manufacturer. Tomorrow, he will take transducers, memory and most of the software problems also. This is the ultimate end of the LSI revolution.

Dr. C. Lester Hogan is Vice Chairman of the Board of Fairchild Camera and Instrument Corporation. Born in 1920 in Great Falls, Montana, Dr. Hogan served as a U.S. Naval Officer during W.W. II. He has a B.S. in Chemical Engineering from Montana State University and M.S. AND PhD degrees in Physics from Lehigh University. His professional life began with Bell Laboratories, followed by a Gordon McKay Professorship in Applied Physics at Harvard University, then on to Motorola Semiconductor Division until 1968 when he joined Fairchild.

Dr. Hogan is acknowledged to be one of today's foremost men of science. Holder of numerous patents in electronics and microwave technology, Dr. Hogan maintains an interested eye on the financial health and growth of the firm while fostering the intangible resources of its science and engineering. He is member of the Board of Directors of several organizations and serves on the Board of Trustees of several universities and colleges. He holds Fellowships in many professional societies.

36 INTERFACE AGE **MARCH 1977**

¹⁷The author acknowledges contributions from many individuals who have spent many hours with him as he was collecting ideas for this paper. In particular, he would like to express his gratitude to Dr. James Early, Bill Howe, A.R. Beccia, and Dave Hahn for helping him formulate some of the ideas expressed here and to Randy Holladay for the graphics.



\$194 for the kaboodle.

38 INTERFACE AGE MARCH 1977

whole kit &



the kaboodle \$99

The kaboodle is our popular SC/MP Kit microcomputer package: SC/MP microprocessor, ROM, RAM, timing crystal, PC Board, and all necessary drive logic. All for just \$99.

The kit is our new, low-cost terminal kit: keyboard display, and special ROM with debug keyboard/display scanning program. All for just \$95.

You don't need a \$500 development system. You don't need a \$1,000 teletype.

You buy our kit and kaboodle, and you're in business. In microprocessors, video games, home control systems, whatever. For training, for learning, for development.

If you'd like complete information, we'll send it to you for nothing.

Or, if you'd prefer the actual microcomputer and terminal kit, that'll be just \$194 extra.

Gentlemen:	r Drive, Santa Clara, CA 95051
Please send me m	nore information.
	real live SC/MP Kit (ISP-8K/200) \$99.
	real live Keyboard Kit (ISP-8K/400) \$95
Here's my check.	(California residents add 6% sales tax.)
Also available at you	
Name	Title
Company	
Address	

THE COMPUTER EVEN A BABY CAN USE

S-100 Bus Microcomputer the Fetal Electrocardiogram

by Kenneth R. Perry, Basil Steele, Rocky Bridges, and Harry Garland

The proliferation of low-cost microcomputers has resulted not only in a large personal computer usage, but also has brought about increased application of the microcomputer into scientific and technical areas. Reversing the usual research and development pattern, for byproducts of space-age technology to find a way into the home, microcomputers enjoyed today by hobbyists in many homes may find a useful role tomorrow in hospital delivery rooms. The new combination of the microcomputer, advanced signal processing technique, and adaptive noise cancelling, may provide a valuable service to the medical community. Equipping a S-100 bus microcomputer such as the Altair 8800 or the Imsai 8080 with a Cromemco A/D and D/A converter board, real-time monitoring of simulated fetal electrocardiograph (ECG) signals has been achieved.

INTRODUCTION

The fetal electrocardiogram is the electrical signal generated by the heart of a fetus. Reference sensors painlessly taped to the surface of the abdomen of an expectant mother can pick up this signal. The fetal waveform is useful in determining the fetal heart rate and detecting multiple feti. This information should be useful in determining fetal maturity and the existence of any fetal distress [1]. The fetal ECG is a valuable parameter to physicians interested in the well-being of the unborn baby. Unfortunately, abdominal recordings contain a fetal signal dwarfed by the maternal heart signal. Using minicomputers, Professor Bernard Widrow of Stanford University has shown that an adaptive noise cancelling technique can significantly attenuate the maternal ECG while leaving the fetal waveform unaltered [2]. The same capability is now available using a microcomputer. The system shown in Fig. 1 uses a S-100 bus microcomputer to implement a real-time adaptive noise canceller.

In fetal ECG monitoring the primary input to the

microcomputer is an abdominal lead which records combined maternal and fetal heart signals. A chest lead is used to record the electrical activity of the mother's heart and provide a reference input. The adaptive noise canceller uses feedback to adjust the mother's ECG presented at the reference input to become as close a replica as possible to the maternal ECG found on the abdominal recording. At each iteration the estimate is improved. Subtraction of the processed reference signal from the primary signal leaves the desired output, a clear fetal waveform.

Figure 2 shows an adaptive noise cancelling system. In fetal ECG monitoring the **noise** is the mother's ECG. The fundamental building block of an adaptive noise canceller is the adaptive filter. The symbolic representation of the adaptive filter shown in Figure 2 is expanded into block diagram form in Figure 3. The adaptive filter output (Y_i) is a weighted sum of present and delayed versions of the reference input. The computational process followed by the microcomputer is the Widro-Hoff LMS algorithm [2]. During each

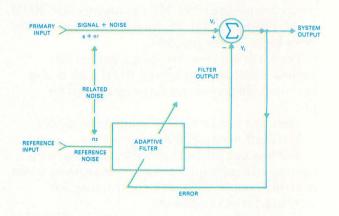


Figure 2. An adaptive noise cancelling system.

40 INTERFACE AGE

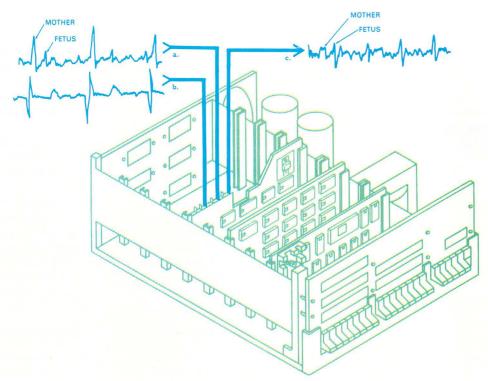


Figure 1. A microcomputer fetal ECG monitor

- (a) The primary input, a combined maternal and fetal heart signals
- (b) The reference input, the mother's ECG.
- (c) The microcomputer output showing the attenuated maternal ECG.

iteration the values of each weight are changed according to this LMS algorithm:

$$W_{i,j+1} = W_{i,j} 2\mu \epsilon_j X_{i,j}$$

The subscript i denotes position, and discrete time is indexed by the subscript j. According to this algorithm the **next** weight, $W_{i,j+1}$, is equal to the present weight $W_{i,j}$, plus a correction factor $2\mu\epsilon_i X_{i,j}$. The parameter μ controls stability and rate of convergence of the algorithm. $X_{i,j}$ represents the reference input signal shifted along the tapped delay line of the adaptive filter. The output of the adaptive noise canceller is ϵ_j .

A MICROCOMPUTER FETAL ECG MONITOR

To show the feasibility of a microprocessor controlled real-time adaptive noise canceller for fetal ECG monitoring, the Intel[™] 8080 μ P was programmed to perform all of the arithmetic required of a five-weight

adaptive filter, plus input data from two parallel A/D input ports and output data to a D/A output port. Readouts are viewed on an oscilloscope and a strip chart recorder. The main problem encountered in implementing a real-time microprocessor-based fetal monitor is speed. The previous minicomputer processing was done off-line and for a 100 weight filter took 23 seconds to process 320 milliseconds of data which had been sampled at 1,000 Hz. The microprocessor with its slower clock rate and less powerful software was initially considered too slow for real-time processing. However, three features added to save time in executing data resulted in a real-time fetal ECG monitor. (1) Minicomputer experimental trials revealed that for certain projections of the maternal ECG, cancellation of the maternal complex could be accomplished with as few as five weights, although a larger filter gave better results.

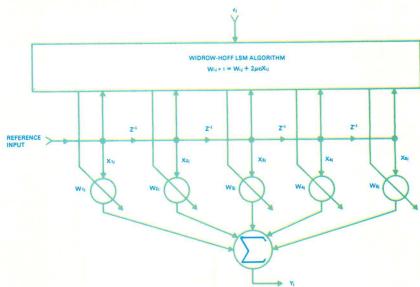


Figure 3. Block diagram of a five weight LMS adaptive filter. The variable weights are represented by a circle with an arrow through them. Z⁻¹ represents a unit time delay. The cascaded time delays form the tapped delay line.

INTERFACE AGE 41

With a microcomputer adaptive signal, the fetal signal is revealed while the maternal signal is attenuated.

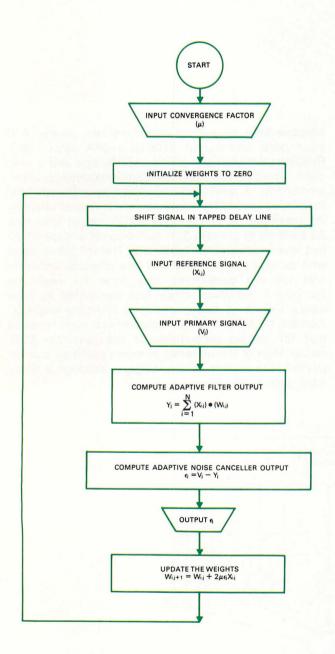


Figure 4. Flow chart of microcomputer program to implement LMS algorithm.

Hence the design of a five weight system was initiated. (2) The first few instructions of the program move the entire program from programmable read only memory (PROM) to random access memory (RAM). About 250 microseconds per iteration are saved by doing this because of the four additional clock periods required to address PROM instead of RAM. (3) The algorithm convergence factor, μ , is made to be a power of two, i.e., $\mu = 2^{-B}$. Therefore, instead of calling the lengthy multiplication routine an additional time, all that is required is a simple shift of the value in the registers to the right B times, being careful to retain the correct sign bit and to insert zeroes between the sign bit and the shifted data. The value of B is stored in the front panel sense switches of the microcomputer.

Incorporating these features into our design gives a reasonably fast and accurate real-time system. For the five-weight system the μ Pgoes through 1308 states to complete one iterative calculation before updating the weights. The time it takes the μ P to complete one iteration is calculated as follows:

Time (msec) = 0.654 + 1.0795(N) + 0.0045(B-1)

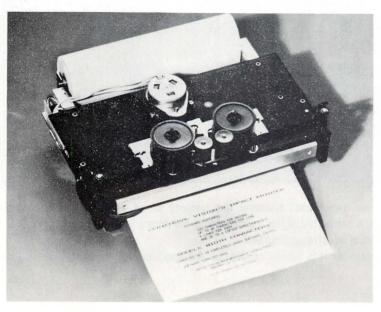
where N is the number of weights in the adaptive filter and $\mu = 2^{-B}$. Therefore, for a five-weight filter the computation time is approximately 6 milliseconds. This is also the sampling interval using a programmed I/O method. This gives a sampling rate of approximately 160 samples per second.

Figure 4 shows a flow chart of the program used to realize the LMS algorithm. The program is stored in only 512 bytes of PROM. The primary and reference imput signals are both 8 bit two's complement words. All the information is processed and stored in two's complement form. The first step in the program, after the program is moved to RAM, is to initialize the stack for the weights and the stack for the tapped delay line outputs to zero. The values of the weights are stored as 24 bit words. The upper sixteen bits of the weight values are used to calculate the adaptive filter output, Y_i . The system output signal, ϵ_i , is then processed and stored as sixteen bits, with the high order byte output to the D/A converter. The multiplication subroutine is written to calculate the products (Xi,j) • (Wi,j), and the partial correction factors, $\epsilon_j X_{i,j}$. The twenty-four bit partial correction factors, $\epsilon_i X_{i,j}$, are then shifted to the right (B-1) times to give the complete correction factors, $2\mu\epsilon_i X_{i,j}$. These values are then added to the previous 24 bit weight values to update the weights. The procedure is repeated continuously.

RESULTS AND CONCLUSIONS

In this work the mother's electrocardiogram, the fetal electrocardiogram, and an additional constant frequency interference were simulated. At the time testing was performed no analog tapes were available of actual recorded data. Figure 5A shows the primary input to the microcomputer, a simulated signal representing a recording from abdominal electrodes. The large spikes represent the maternal QRS complex. The smaller spikes represent the electrical signals generated from the baby's heart. There is also some additional sinusoidal noise. Figure 5B shows the reference input, a simulated signal representing the mother's ECG. Figure 5C shows the output from the

Peripheral Vision impacts your computer.



WITH A
FULL-SIZE,
LOW-COST
IMPACT
PRINTER.

Until now, the hobbyist and small businessman have had one major problem in assembling a reasonably price microprocessor system with the capabilities found in the more costly computers. It was impossible to find a high-quality, high-output printer for hard copy needs at an affordable price.

Peripheral Vision has come up with a solution.

We are offering a full-size *impact* printer designed for microprocessors—and it comes with a mini price. Kit prices start as low as \$495 for the printer and interface card. And that won't impact your pocketbook.

Peripheral Vision's printer is loaded with capabilities. Take a look:

- It's fast-120 characters per second
- 96 characters per line, 12 characters per inch horizontal, 6 lines per inch
- · Makes up to 4 copies simultaneously
- Character set and pitch variable under software control
- 5 x 7 character matrix
- · Ribbon has built-in re-inkers for a life of 10,000,000 characters
- Paper can be either a standard 8½-inch roll, fanfold or cut page
- Interfaces to 8-bit parallel ports

Just remember, Peripheral Vision is committed to helping you get along with your computer. The new printer we are offering is another example. It is high quality, low in cost and will definitely impact your system.

Write or call now to find out how to impact your computer.



P.O. Box 6267 Denver, Colorado 80206 (303) 777-4292

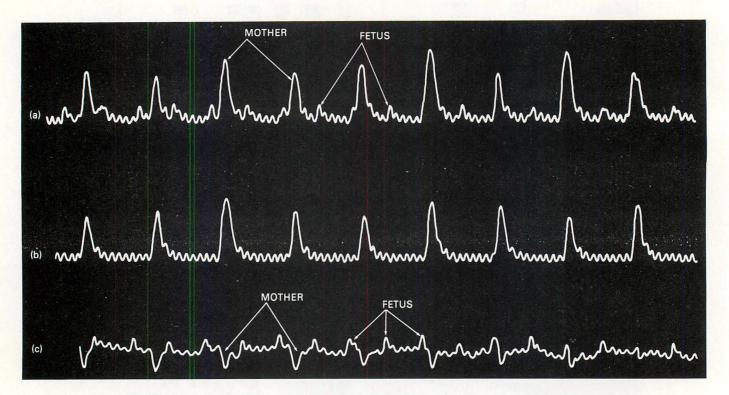


Figure 5. Results of real-time microcomputer experiment showing the training of an adaptive noise canceller.

- (a) The primary input to the microcomputer, a simulated signal representing combined maternal and fetal ECG signals.
- (b) The reference input, a simulated maternal electrocardiogram.
- (c) The output from the microcomputer as soon as it is turned on. Notice the amplitude of the maternal ECG decreases with time.

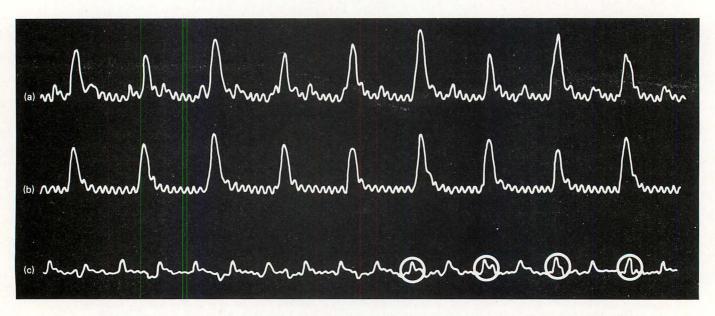


Figure 6. Results of real-time microcomputer experiment showing adaptive noise canceller output when the maternal and fetal signals overlap.

- (a) The primary input
- (b) The reference input
- (c) The microcomputer output. Circled fetal complices were not visible on the primary input but the microcomputer has pulled them out of the *noise* (the mother's ECG).



MICROCOMPUTING FOR HOME AND THE SMALL BUSINESSMAN

The professional publication bringing microcomputing technology to the hobbyist, small businessman, educator, engineer and student. Every issue edited to bring technology and people together in the simplest manner.

INTERFACE AGE is packed with

- HARDWARE ARTICLES Product profiles, comparisons, applications, modifications and construction projects.
- SOFTWARE ARTICLES Microcomputer development software, short software routines, application software, off-line software storage formats, software communication standards and access to the microcomputer software depository for all INTER-FACE AGE readers.
- TUTORIALS Fundamentals of micro processors, basics for microcomputing, professional to technical transition information, understanding software, elementary math for computing.
 - NEW PRODUCTS Manufacturer profiles and latest product releases.
 - USER COMMUNICATION UPDATE devoted to club and organization announcements and activities. — LETTERS TO THE EDITOR — Reader forum for expression of opinions and feedback on articles and features.
 - MICRO-MARKET/FIFO FLEA MARKET Low cost/no cost advertising for the new marketeer/garage sale enthusiast.

If you need to know how to get started in microcomputing or need the valuable software once your system is completed then **INTERFACE AGE** is a must for you.

Don't Delay — Subscribe Today!

			 IAGAZINE			
P.O. Box 1234 Cerritos, CA. 90701				\$10 U	I.S., \$1	onthly Issues 2 Can./Mex. Internationa
		CHECK	MONEY C	RDER		
Name	100	And a variable				
Address				o Early		
City				State_		_ Zip
Country						

MARCH 1977 INTERFACE AGE 45

CRT Terminals



- Includes:
 12" CRT; 64-key keyboard; line driver/receiver; power supply; plastic cover and bezel
- TTL input levels; 12.5MHz video bandwidth
- A high quality unit; ideal for microcomputer applications
- Fully assembled, not a kit
- Only \$195 in single unit quantities (FOB Hampton, Va.; no COD)

WYLE COMPUTER PRODUCTS

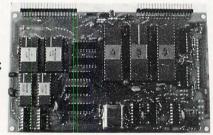
3200 Magruder Blvd. Hampton, Va. 23666 (804) 838-0122

CIRCLE INQUIRY NO. 28

SUPER JOLT features TINY BASIC, ASSEMBLER and DEBUGGER ROMs on board!

READY TO RUN IMMEDIATELY! CONNECT THIS CARD TO MOST ANY TERMINAL AND YOU'VE GOT ALL THE MICROCOMPUTER HARDWARE AND SOFTWARE PROGRAMS YOU MAY EVER WANT.

ON ONE SINGLE 4¼" x 7" PC CARD YOU GET ALL THIS:



FULLY ASSEMBLED AND TESTED

• 8-bit 6502 processor • 1,024-byte static RAM • 32-bidirectional, programmable I/O lines • 1 MHz crystal controlled clock • interval timer • 4 interrupts, including timer and non-maskable • 3 serial interfaces: 20 mA current loop, RS 232 and TTL • 5,120 bytes resident ROM software including a single pass symbolic assembler, a TINY BASIC and a Debug Monitor.

AVAILABLE NOW. \$375 without assembler and TINY BASIC ROMs, \$575 with. ORDER DIRECT or at participating computer stores. Other systems, cards and kits also available from \$96.

PHONE (408) 247-8940 MICROCOMPUTER ASSOCIATES, INC. 2589 Scott Blvd., Santa Clara 95050

CIRCLE INQUIRY NO. 29

microcomputer, as soon as it is switched on. The adaptive filter trains itself on the first few maternal complices, adjusting its internal parameters approximately 160 times per second, until by the eighth maternal QRS complex, the microcomputer has adjusted itself such that all future maternal complices are attenuated, while the fetal signals remain relatively unchanged! By the time the ninth maternal complex is reached, the output shows the amplitude of the fetal signal to be greater than the amplitude of the maternal signal.

The future of the microcomputer in medical electronics seems unbounded.

But what happens when the fetal and maternal signals overlap? This is one of the advantages of using an adaptive filter. Since part of the power spectrum of the fetal and maternal signals overlap, conventional frequency domain filtering techniques attenuate both the fetal and maternal signals. Figure 6 shows that with a microcomputer-controlled adaptive system even when the two signals overlap, the fetal signal is revealed while the maternal signal is attenuated.

Adaptive filtering offers another reward currently not available in any other fetal ECG processor. Now, not only is the fetal heart rate determined, but since no filtering is performed on the signal picked up by the abdominal electrodes, the output also contains undisturbed information about the shape of the fetal electrocardiogram. This gives the physician a tool to detect fetal arrhythmias (abnormalities in the electrical conduction system of the baby's heart).

The capability of this system is presently being futher expanded by using digital hardware multipliers and a faster microprocessor.

The future of the microcomputer in medical electronics seems unbounded. Presented here is but one of the many applications of the microprocessor to the medical researcher or practicing physician. Some other applications have already been reported, and certainly many more will follow.

References

- 1. J. H. Van Bemmel, *Detection and Processing of Fetal Electrocardiograms*, Utrecht: Institute of Medical Physics TNO, 1969.
- 2. B. Widrow, et al, *Adaptive Noise Cancelling: Principles and Applications*, Proc IEEE, Vol. 63, pp. 1692-1716, Dec. 1975.

Biographical Sketches

- Kenneth R. Perry is a graduate student at Stanford University pursuing a Ph.D. in electrical engineering. He is supported by a Xerox Palo Alto Research Corporation fellowship.
- Rocky Bridges is an electrical engineer at Sandia Laboratories, Livermore, California.
- Basil J. Steele is an electrical engineer at Sandia Laboratories, Albuquerque, New Mexico.
- Harry Garland is the Assistant Chairman of the Electrical Engineering Department at Stanford University.

NEW PRODUCT GUIDE



THIS NEW PRODUCT GUIDE HAS BEEN COMPILED AS A SPECIAL FEATURE TO INTRODUCE THE MANY NEW PRODUCTS AND COMPANIES ENTERING THE HOME COMPUTING MARKET. THIS IS ONLY A VERY SMALL TIP-OF-THE-ICEBERG LOOK AS MANY NEW MANUFACTURERS ARE EVOLVING DAILY.

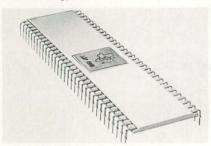
	PAGE	READER SERVICE CARD NO.*
MICROPROCESSORS	. 48	385
MICROCOMPUTERS	. 50	386
PERIPHERALS	. 64 B	387
PAPER TAPE EQUIPMENT	. 68	388
DIGITAL RECORDERS	. 69	389
DISCS	. 70	390
TERMINALS	. 72	391
I/O CARDS	. 73	392
MEMORY CARDS	. 78	393
TEST EQUIPMENT	. 81	394
POWER SUPPLIES	. 82	395
COMPONENTS	. 84	396
LITERATURE	. 87	397
SOFTWARE	. 92	398
MISCELLANEOUS	. 94	399

*SHOULD YOU WISH INFORMATION ON ALL ITEMS IN A SECTION, CIRCLE THE NUMBER INDICATED IN THE RIGHT HAND COLUMN ABOVE ON THE READER SERVICE CARD.

Microprocessors

16-BIT I2L Microprocessor

The new microprocessor, designated SBP 9900, is a ruggedized full-temperature (-55°C to +125°C) 16-bit microprocessor believed to be the first monolithic central processing unit produced with bipolar Integrated Injection Logic (I²L) technology.



Key features include: Parallel 16-bit word length; Full minicomputer instruction set includes multiply and divide; Directly addresses up to 65,536 bytes/32,768 words of memory; Advanced memory-to-memory architecture; Multiple 16-word register files (work spaces) reside in memory; Seven addressing modes; Separate I/O, memory and interrupt bus structures; Sixteen prioritized hardware interrupts; Word, byte and bit data handling; Sixteen software interrupts (KOPS); DMA capability; Parallel I/O via separate data and address buses; Serial I/O via communications-register-unit (CRU); Software compatible with TI 9900 microprocessor/990 minicomputer family; I²L technology for: -55°C to +125°C ambient temperature range; User selectable speed/power operation with typical clock frequency range from dc to 3 MHz; Fully static operation; Single non-critical do power supply; Directly TTL compatible input/outputs (including clock)

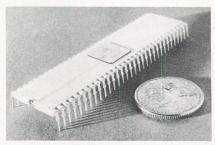
Supplied in a 64-pin ceramic DIP and rated for operation at ambient temperatures ranging from -55°C to +125°C, the SBP 9900 sells for \$386.00 at the 100 piece level.

For further information contact Texas Instruments Incorporated, Inquiry Answering Service, P.O. Box 5012, M/S 308 (Attn. SBP 9900), Dallas, Texas 75222. Marketing Contact: Robert Bergeler (713) 494-5115, Ext. 2621.

CIRCLE INQUIRY NO. 200

Additions To T.I.'s 9900 MP Family

DALLAS, July 20, 1976 ... Texas Instruments, Inc. will add a new microprocessor and four peripheral circuits to its TMS 9900 family to expand the applications spectrum of all 9900-series products.



The TMS 9980 is a new MOS micro-

processor — a lower performance version of the powerful 16-bit TMS 9900 microprocessor. It is packaged in a 40-pin DIP, and like the TMS 9900, it is a 16-bit central processing unit and executes the full 9900 instruction set including hardware multiply and divide. It features an 8-bit data bus and a 16-bit address bus, making it compatible with byte-oriented microprocessor memories.

The same flexible I/O system is employed as on the TMS 9900, offering the user capability to do D.M.A., memory mapped I/O, or the easy-to-use serial I/O port (the Communications Register Unit, or CRU). Six interrupts including a non-maskable interrupt and reset will be available.

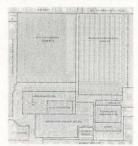
The oscillator and clock generator of the 9980 will be contained on-chip. The new microprocessor is targeted to be extremely cost effective in systems requiring smaller memory size and less I/O, particularly where board space and chip count may be critical. The TMS 9980 will compete head-on in the medium performance range with currently available 8-bit MPU's such as 8080 or 6800. The 9980 gives TI a complete software compatible family including: TMS 9900 16-bit microprocessor, 990/4 microcomputer and 990/10 minicomputer implemented in TTL. TMS 9980 samples are scheduled for 4Q76.

For further information contact TEXAS INSTRUMENTS INCORPORATED, P.O. Box 5012, MS/84, Dallas, Texas 75222, Attn: "9900 Family", Marketing contact: Al Lofthus (713) 494-5115.

CIRCLE INQUIRY NO. 201

New COP Series

A new series of calculator-oriented processors (COPS), fill the gap between general-purpose microprocessors that are often too powerful, and dedicated custom circuits that take too long to develop, has been designed by national Semiconductor Corp. The new family of COPS consists of the MM5781 and MM5782 set, the single-chip MM5799 controllers and the simplified MM57140, each of which contains all that's necessary to implement most dedicated control applications for less than \$10.



Each controller includes a clock generator, central processing unit, read-only control memory, random-access memory, parallel inputs, and programmable outputs, plus a variety of single-bit input/output ports that are under program control. And each can connect directly to keyboards, displays, A-to-D and D-to-A converters, and drive motors, relays and similar devices through a buffer.

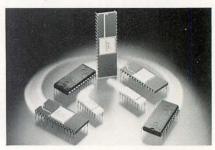
For further information contact National Semiconductor, 2900 Semiconductor Drive, Santa Clara, CA 95051; Telephone (408) 737-5000 TWX: 910-339-9240.

CIRCLE INQUIRY NO. 202

New Products To 8080A Microprocessor Family

An expanded line of interface and support circuits for the 8080A microprocessor family plus two new additional versions of the 8080A CPU are now available from National Semiconductor Corp.

National's pin-for-pin and function-forfunction replacement for the INTEL 8080A device, available since June, is being joined by the INS8080A-1 and INS8080-@. The original 8080A has a 2 microsecond minimum time rating, while the 8080A-1 features a 1.3 microsecond cycle and the 8080A-2 has a 1.5 microsecond cycle.



The interface devices being introduced include an 8-bit input-output port (DP8212), a clock generator and driver (DP8224) and a single-chip system controller and bus driver (DP8228, DP8238), all built using Schottky Polar Technology. Two other interface circuits, a microprocessor interface latch element (MILE) manufactured by silicon-gate CMOS process (DP8301) and an 8-bit bi-directional bus transceiver fabricated by low-power Schottky process (DP8304) should be available by March 1.

Further information about National's 8080A microprocessor family and support devices is available from National Semiconductor Corp., 2900 Semiconductor Drive, Santa Clara, CA 95051.

CIRCLE INQUIRY NO. 203

AMD Offers New 20-Pin ALU

Advanced Micro Devices is now producing two high-performance, low-power Schottky devices that combine the key functions of the popular Am54/74LS181 4-bit ALU with the convenience of the slim 20-pin package.

The Am25LS381 performs three arithmetic functions (A minus B, B minus A and A plus B) and three logic functions (A \oplus B, A + B and A.B) on two 4-bit words. $\overline{\mathbb{G}}$ and P outputs are provided for full carry look ahead operations.

Both devices are available in 20-lead molded and hermetic DIP and ceramic flat packages. And, as with all Advanced Micro Devices' circuits, these ALU's undergo 100 percent processing to the requirements of MIL-STD-883.

Prices for the AM25LS381 start at \$2.94 in 100-piece lots and are available nationally from Hamilton/Avnet. Schweber or Cramer Electronics and regionally from Arrow, Bell and Century Electronics.

For further information contact E. Sopkin, Advanced Micro Devices, Inc., 901 Thompson Place, Sunnyvale, CA; (408) 732-2400.

Now you can buy an Altair 8800b or an Altair 680b computer right off the shelf. Altair plug-in boards, peripherals, software and manuals are also available. Check the list below for the MITS dealer in your area.



off the shelf.

ALTAIR COMPUTER CENTER 8105 SW Nimbus Ave. BEAVERTON, OR 97005 (503)-644-2314

COMPUTER KITS 1044 University Ave. BERKELEY, CA 94710 (415)-845-5300

THE COMPUTER STORE 820 Broadway SANTA MONICA, CA 90401 (213)-451-0713

GATEWAY ELECTRONICS, INC OF COLORADO 2839 W. 44th Ave. **DENVER, CO 80211** (303)-458-5444

COMPUTER SHACK 3120 San Mateo N.E. **ALBUQUERQUE, NM 87110** (505)-883-8282; 883-8283

ALTAIR COMPUTER CENTER 4941 East 29th St. TUCSON, AZ 85711 (602)-748-7363 ALTAIR COMPUTER CENTER 611 N. 27th St. Suite 9 LINCOLN, NB 68503 (402) 474-2800

COMPUTER PRODUCTS UNLIMITED 2412 Broadway LITTLE ROCK, AR 72206 (501)-371-0449

ALTAIR COMPUTER CENTER 110 The Annex 5345 East Forty First St. TULSA, OK 74135 (918)-664-4564

ALTAIR COMPUTER CENTER 5750 Bintliff Drive Suite 206 HOUSTON, TX 77036 (713)-780-8981

COMPUTERS-TO-GO 4503 West Broad St. **RICHMOND, VA 23230** (804)-355-5773

MICROSYSTEMS (Washington, D.C.) 6605A Backlick Rd. **SPRINGFIELD, VA 22150** (703)-569-1110

THE COMPUTER STORE Suite 5 Municipal Parking Building CHARLESTON, W. VA. 25301 (304)-345-1360 THE COMPUTER ROOM 3938 Beau D'Rue Drive **EAGAN, MN 55122** (612)-452-2567

THE COMPUTER STORE OF ANN ARBOR 310 East Washington Street ANN ARBOR, MI 48104 (313)-995-7616

THE COMPUTER STORE, INC. (Hartford area) 63 South Main Street WINDSOR LOCKS, CT 06096 (203)-627-0188

CHICAGO COMPUTER STORE 517 Talcott Rd. PARK RIDGE, IL 60068 (312)-823-2388

GATEWAY ELECTRONICS, INC. 8123-25 Page Blvd. ST. LOUIS, MO 63130 (314)-427-6116

ALTAIR COMPUTER CENTER DAYTON, OHIO 45403 (513)-252-6785

THE COMPUTER STORE, INC. 120 Cambridge St. BURLINGTON, MA 01803 (617)-272-8770

ALTAIR COMPUTER CENTER 269 Osborne Road ALBANY, NY 12211 (518)-459-6140

THE COMPUTER STORE OF NEW YORK 55 West 39th Street **NEW YORK, NY 10018** (212)-221-1404

THE COMPUTER SYSTEMCENTER 3330 Piedmont Road ATLANTA, GA 30305 (404)-231-1691

MARSH DATA SYSTEMS 5405 B Southern Comfort Blvd. TAMPA, FL 33614 (813)-886-9890



Microcomputers

New Modules Added To Microprocessor Learning System

DALLAS, August 6, 1976 ... Three preassembled, add-on modules to the Texas Instruments Microprogrammer Learning Module are available. The self-contained units, controller, memory and input/output, complete the userpaced system for understanding microprocessors and provide a training ground for basic software and hardware development.



Further details about each of the four system modules follows:

LCM-1001 Microprogrammer Module: With this basic building block, a user learns microprogramming principles through single-clock-step micro instructions. The microprogrammer contains a 4-bit static parallel processor with manual switch inputs, VLED monitors, and manual clock pushbutton.

LCM-1002 Controller Module: A 256 X 20 PROM (five chips) is used to store macro instructions, each containing eight or 16 micro instructions. Like conventional micorcomputers, the module also has a memory data register, instruction register, and program counter.

LCM-1003 Memory Module: This standalone, read/write static RAM is organized as 1024 words of 12 bits each. While micro instructions are stored in the PROM memory in the controller, macro instructions are stored in the LCM-1003 RAM. The 12-bit instruction word provides an operation code and an operand address. The 1024 words may include instructions, constants, or variable data.

Prices for the learning modules are: LCM-1001 Microprogrammer, \$149.95; LCM-1002 Controller, \$189.95; LCM-1003 Memory, \$189.95.

For further information contact Texas Instruments Incorporated, Inquiry Answering Service, P.O. Box 5012, M/S 308 (Attn: M.P. Modules), Dallas, Texas 75222.

CIRCLE INQUIRY NO. 205

Wyle µP Microcomputer System

Wyle Computer Products, a division of Wyle Laboratories, announces a new modular microcomputer system, complementing its extensive line of printed circuit logic cards, card files, power supplies and accessories.

The μP series microcomputer system of circuit logic cards is designed with major subsystems on individual logic cards to allow the designer flexibility in configuring memory and I/O structure. The card size is directly compatible with the existing Wyle logic card line, allowing for interface development and packaging in the same card file with the microcomputer system. A unique aspect of the μP Series is the availability of an interface to the DEC PDP-11, which allows the PDP-11 to exercise full control over the

microprocessor address, control and I/O buses. This along with a proprietary Microprocessor Online Development System (MODS) and cross assembler, also available from Wyle, allows the user to completely develop and debug microcomputer software utilizing the larger system. A RAM/ROM memory module is available for program development directly on the microcomputer system.

For further information contact WYLE COM-PUTER PRODUCTS, 3200 Magruder Boulevard, Hampton, Virginia 23666; (804) 838-0122.

CIRCLE INQUIRY NO. 206

New Turnkey Version Features AUTO-START Programs Executed Immediately

The Altair 8800b Turnkey computer incorporates all the quality construction and good looks of the Altair 8800b computer in addition to such new features as AUTO-START, which allows automatic execution of a program in PROM as soon as the power is turned on.



With the new Turnkey Module board, all the functional units of the computer — the CPU, RAM and PROM memory, sense switches and serial I/O — can be contained on just two circuit boards, which are supplied in the standard Turnkey version package. However, the system has the same expandable ability as the full front panel model 8800b computer. The board consists of a serial I/O channel that can operate with a variety of devices, 1K byte each of RAM and PROM as well as logic for the AUTO-START feature. A keylock switch prevents unauthorized power on or power off.

Software support includes a Monitor PROM and bootstrap loaders for Altair BASIC.

For further information contact MITS, 2450 Alamo S.E., Albuquerque, NM 87106.

CIRCLE INQUIRY NO. 207

Data-Catcher

DATA-CATCHER is an option for the MICRO-68 line of 6800 Microprocessor prototype development systems.



The DATA-CATCHER provides for single step

operation of the MICRO-68 and captures address and operand after the completion of each machine instruction and displays the data on an integral 6 digit hexdisplay. This feature provides for easy debugging of new programs written by the user. The DATA-CATCHER is available from stock as an option to EPA's expanded-68 Micro-computer system for \$140.00.

For further information contact Electronic Product Associates, Inc., Director of Marketing, 1157 Vega Street, San Diego, CA 92110; (714) 276-8911.

CIRCLE INQUIRY NO. 208

RCC's Z//100 Series of Portable Microcomputer Systems

Realistic Controls Corporation (RCC) announces a new line of table-top micro-computer systems, the Z//100 Series, dubbed "The Personal FORTRAN Machines"



The Z//100 systems are available with a monitor, a complete file management system and FORT//80, RCC's previously announced 8080 resident FORTRAN IV compiler.

Priced at \$7995, the Z//100-1 includes 36K bytes of RAM, dual diskette drive, and two EIA RS-232-C serial communications channels. One channel can be ordered with a 20 Ma current loop interface.

Delivery is 30 days ARO.

For further information contact Realistic Controls Corporation, 3530 Warrensville Center Road, Cleveland, OH 44122; (216) 751-3158.

CIRCLE INQUIRY NO. 209

ECT-100 Microcomputers

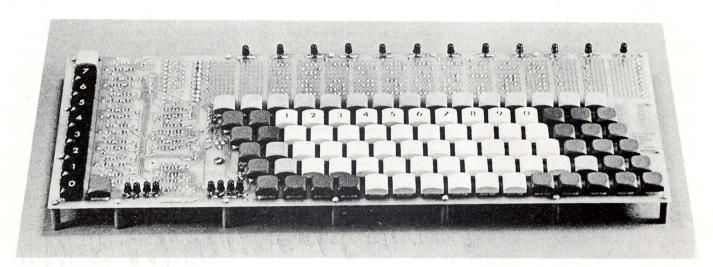
ECT-100 Microcomputers are engineered for use in dedicated control applications, turnkey systems or other Microcomputer systems applications.

The ECT-100 Card Cages are of rugged construction and fit the industry standard 19 inch cabinetry occupying seven RETMA increments (12.25 inches). They hold 20 printed circuit boards 10 x 5.3 on 34 inch centers which are removable from the front for easy accessibility. The bus structure is the standard 100 pin bus of the personal computers ("Altair" bus or S-100 bus). A wide variety of cards are available from more than 30 manufacturers: ECT-100 Card Cage; ECT-100-8080, A 8080 based Microcomputer; ECT-100-Z80, A Z80 based Microcomputer;

Prices start at \$100.

For further information contact Electronic Control Technology, P.O. Box 6 Union, New Jersey 07083.

Versatility CEI/Custom Keyboards have it



What goes on these keys is up to you

Our aim at CEI is to provide you the hobbiest, with a keyboard system that can perform any task you could possibly demand. Diode encoding coupled with one switch register encoded key allows complete latitude in key definition. Both positive and negative going strobes are provided for interfacing. Visual indication of keyboard status is provided by 22 LED's, 13 of which can have user defined meaning. Shift and shift lock are provided

Unliminted versatility w/100 Keys

90 are encoded off of a diode matrix and are fully user defined.

1 - is encoded by an 8 switch register to allow easy redefination

1 - on board reset key

Diode encoding allows a multitude of encoding techniques. ECIBIC, ASCII, BAUDOT, RADLX 50, FIELDATA or codes of your own design. Complete documentation Computer Electronics Inc. 37433 Centralmont Place Fremont, Calif. 94536 Phone (415) 796-5760

- □ Send ____ KB3A Kit. Supplied with all switches, diodes, PC board, TTL-IC's, +5v. regulator, connecting ribbon cable \$95.95
- □ Send ____ KB3B Kit. Same as above except without diodes, TTL-IC's, +5v. regulator & ribbon cable. \$49.95
- □ Case for above \$29.95

NAME ________
ADDRESS _______
CITY/STATE/ZIP ______
NOTE: Calif. residents add

INTERFACE AGE 51

6% sales tax

MARCH 1977 CIRCLE INQUIRY NO. 31

New Microprocessor Evaluation Design Kit II

Motorola's new microprocessor evaluation design kit features 24 key keyboard, 7 segment display, cassette interface, EPROM expandable, wire wrap capability, interface capability, single 5 volt supply required, layout on boards and documentation.



Hardware features include 16 I/O Lines and 4 Control Lines. Firmware features a J-Bug Monitor. This monitor allows the user to communicate with and control the M6800 Microcomputer by using the hexadecimal keyboard and display module.

Expandability features the MPU Module Card prewired for ease of expandability capable of accepting: 2-MCM6810-128 X 8 RAM's, 3-MC8T96-Address Buffers, 2-MC8T26 Bidirectional buffers.

By adding optional buffers in the space provided, the kit may be upgraded to EXORciser compatible status.

The MEK6800D2 Kit has all the parts necessary to complete the M6800 Microprocessor system for only \$235.

For further information contact Motorola Semiconductor Products, Inc., P.O. Box 20912, Phoenix, AZ 80536. Telephone (602) 244-3464.

CIRCLE INQUIRY NO. 211

System with Rebuilt TTY 33 Printer

A self-contained minicomputer system complete with a rebuilt Teletype Model 33 printer is available from Mini Micro Mart. Input is from an electronic keyboard, and a 25 line x 40 character video display interface is provided, as well as the hard copy printer. (The user supplies a video monitor or modified TV set.)



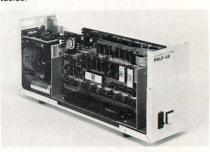
There is a choice of directly interchangeable, busable CPU boards; an 8080 version, a 6800 version, and a Z80 version. All of the CPU boards provide for both serial and parallel interfaces the main board as well as for PROM or ROIN. The complete system includes an operating monitor in PROM or ROM. An audio cassette interface is also a part of the standard package.

The complete kit, including 4K of 300 ns memory with a used Teletype, is available at \$995. With a rebuilt printer and in an assembled and tested form, it is available at \$1395. Versions without the printer or video interface are available. Additional memory is available for as little as \$99.95 per 4K board. A 5K BASIC compiler is included without extra charge. Write or phone for details. Mini Micro Mart, 1618 James Street, Syracuse, NY 13203; (315) 422-4467.

CIRCLE INQUIRY NO. 212

POLY 88 System Two

The POLY 88 System Two kit provides the central core for attaining your computing fantasies



Popular 8080A Central Processor Unit features ½K RAM on card, 1K monitor with room for two more ROMs, real-time clock, 8 level vectored interrupt, serial communication ports.

Byte/Polyphase Cassette Interface Mini-card features selectable baud rate.

Chassis features S100 compatible, 5 card slots, rugged 6A power supply, up to four chassis may be plugged together.

The firmware monitor provides a front panel on the video display, a tape input routine, and debug aids including the ability to single step through a program. The real time clock and vectored interrupts are also serviced by the monitor, providing a system architecture for development of truly elegant software systems. The complete assembly, theory and operation manual allows you to get the System Two kit up in a few evenings. \$690.

For further information contact PolyMorphic Systems, 460 Ward Drive, Santa Barbara, CA 93111

CIRCLE INQUIRY NO. 213

OUR COMPUTER MAKES MUSIC!

HERE'S HOW:

EQUALLY TEMPERED DIGITAL TO ANALOG CONVERTER

Unlike more conventioanl R-2R ladder type digital to analog converters, the PAIA 8780 kit is based on a multiplying principle that allows the module to generate the exact exponential stair-step function required to make even the simplest linear response oscillators and filters produce equally tempered musical intervals. The 8780 uses only six bits of data to generate over 5 octaves of control voltage. In an 8 bit system, the remaining 2 bits are ordinarily reserved for trigger flags, but may be used to extend the range of the converter or provide for micro-tonal tunings.

The module is physically and electrically compatible with the complete line of PAIA music synthesizer modules and is easily interfaced to any micro-processor with or without hand-shaking logic. #8780 D/A CONVERTER Kit..... \$34.95 (plus \$1.00 postage)

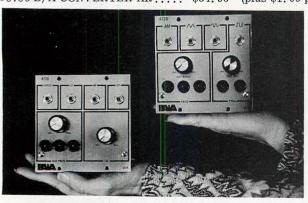


MUSIC SYNTHESIZER MODULES

PAIA offers a complete line of low-cost voltage controlled music synthesizer module kits including the 4720 Oscillator and 4730 Filter shown. Both units feature linear freq./control voltage response and 16 Hz. to 16 kHz. range. The 4720 VCO produces ramp, triangle, sine and pulse waveforms. The companion 4730 VCF is a state variable design with simultaneously available low-pass, band-pass and high-pass outputs, all with "Q" adjustable from .5 to 150.

Other modules available include: Voltage Controlled Amplifiers, Balanced Modulators, Envelope Generatros, Reverb Units, Noise Sources and Power Supplies. All modules are compatible with the PAIA 8780 Equally Tempered DAC for easy computer/micro-processor/micro-controller interface and are designed to play through any hi-fi or musical instrument amplifier.

#4720 VCO kit \$34.95 .. (plus \$1.00 postage) #4730 VCF kit \$37.95 .. (plus \$1.00 postage)



PASA ELECTRONICS

DEPT 3-F 1020 W. WILSHIRE BLVD. OKLAHOMA CITY, OK 73116

DETAILS ON THESE & MORE IN OUR FREE CATALOG

State-Of-The-Art/Low-Cost Microcomputer For Dedicated Work

The Z-2 has a fast 250-nanosecond cycle time, the power of the Z-80 μP , and many special features.



A significant feature of the new Z-2 is that it uses the Z-80 microprocessor, generally considered to be the standard of the next generation of microprocessors. The Z-80 has much more power and speed than such previous popular chips as the 8080, 6800, etc.

Essentials of the Z-2 — The new Cromemco Z-2 is designed to provide the engineer or even the hobbyist with the industry's fastest and most powerful microcomputer in a form especially convenient to application in dedicated industrial, educational, instrumentation, laboratory, business and other work.

Kit or assembled — The Z-2 is available in either kit or assembled form. The kit comprises the Z-2 for rack mounting, the Cromemco 4 MHz microprocessor card, the full-length 21-slot motherboard, heavy duty power supply, one card socket and card-guide set, and front panel.

The assembled Z-2 includes the above as well

The assembled Z-2 includes the above as well as all 21 sockets and card guides and a cooling fan

Price/delivery — Price of the Z-2 in kit form is only \$595, thus giving the engineer, hobbyist, etc., a very low entry figure into the high performance microcomputer field.

Price of the Z-2 assembled is \$995, still a low figure for the essentials of a microcomputer with 4 MHz speed and Z-80 power.

Delivery is from stock to 30 days.

For further information contact Joe McCrate, Cromemco, Inc., 2432 Charleston Rd., Mountain View, CA 94043; (415) 964-7400.

CIRCLE INQUIRY NO. 214

Cromemco Introduces A New CPU Card

Cromemco has introduced a new CPU card based on the new Z-80 microprocessor.

The new card uses a selected version of the Z-80, a version having a clock rate of 4 MHz (which is twice as fast as those using previous microprocessors).



The new CPU card is designed as an easy way for the user to apply the Z-80 chip to his circuitry or system. The card is plug-compatible with existing microcomputers and uses the industry-standard "S-100" computer bus which is supported by more than a dozen manufacturers.

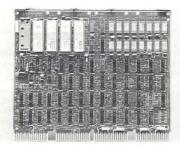
The new card is priced at \$295 in kit form or \$395 assembled. Delivery is 15 - 30 days.

For further information contact Joe McCrate, Cromemco, 2432 Charleston Road, Mountain View, CA 94043; (415) 964-7400.

CIRCLE INQUIRY NO. 215

LSI-11 Microcomputer on a board

The most versatile instruction set in the micro market — all the instructions of the PDP-11/34.



Raw compute speed — 400ns micro cycle

Real arithmetic power — multiply-divide, integer and floating point arithmetic. Floating point multiply, typically 64 µsec.

Powerful software, proven on over 25,000 PDP-11's. For engineering, diagnostics and resident debugging. Three operating systems — RT-11, RSX-11S, and PTS-11. Three high level languages — FORTRAN, BASIC and FOCAL. And a whole library of applications.

Users also get 16-bit architecture, a bidirectional asynchronous, 33-line I/O bus that's far simpler than any 8-bit design, the only nonvolatile core memory option in the micro marketplace, the ability to expand up into the rest of the famous PDP-11 family, plus the kind of reliability that's made Digital the number one company in microcomputers.

For further information contact Digital Equipment Corporation, Components Group, One Iron Way, Marlborough, MA 01752; (617) 481-7400 TWX 710-347-0348

CIRCLE INQUIRY NO. 216

Without our software, we're just another flasher.



Let's face it. No microcomputer is worth a dime if you can't make it work. Even E&L's Mini-Microdesigner would be just a "light flasher" if it weren't for our software system.

But the fact is that our tutorial software is the best in the business. Not just a pathetic rehash of chip manufacturers' specifications. But a clearly written, step-by-step instruction that teaches you all about the microcomputer. How to program it, how to interface it, how to expand it.

The teaching material is written by Rony/Larsen/Titus (authors of the famous Bugbooks). It's called Bugbook V. And it teaches through experiments designed specifically to get you up to speed on our Mini-Microcomputer (MMD-1). And you don't need any prior knowledge of digital electronics!

The best news? E&L's MMD-1 costs \$422.50* in kit form, including all software and teaching material. And now it's available locally from your nearest computer store. Stop in today and get the whole picture. MMD-1. The finest microcomputer system on the market.

*Suggested resale price U.S.A



E&L INSTRUMENTS, INC.

61 First Street, Derby, Conn. 06418 (203) 735-8774 Telex No. 96 3536

Dealer inquiries invited.



QUICKRUN — Memory Resident Micromputer Development Concept

The MICROKIT-8/16 Universal Microcomputer Development System is now available with QUICKRUN, an exclusive MICROKIT software system.



QUICKRUN is a complete "in memory" operating system for developing 8080 or 6800 microcomputer programs. It runs in 32 kilobytes of memory and consists of a Monitor/Debugger, Editor and Assembler all co-resident in memory along with a source code workspace and an object code work space. The 32 K memory configuration provides enough space for a 1000 statement source program, a 4 kilobyte object area and all the system software.

The QUICKRUN system for either the 8080 or 6800 microprocessor is available for delivery in less than 30 days.

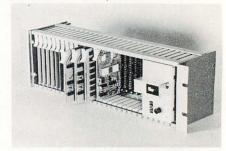
Price for the MICROKIT-8/16 with QUICKRUN for either 8080 or 6800, complete with 32 kilobytes of memory, dual cassette tapes and ultra high-speed CRT console is \$5,275.00.

For further information contact Microkit, Inc., 2180 Colorado Ave., Santa Monica, CA 90404; (213) 828-8539.

CIRCLE INQUIRY NO. 217

Wyle µP Series Microcomputer System

Special hardware and software features of the μP Series greatly minimize time consuming detailed design and programming commonly associated with microprocessors.



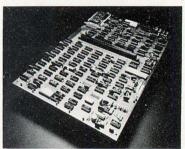
Features of the Wyle μP Series include: A complete family of CPU, memory and I/O modules on individual printed circuit boards which interconnect directly, with no userdesigned buffering required; Analog and digital I/O modules and communications interfaces operable over the range of 0°C to 70°C.; User oriented front panel with switches and lighted displays for data input, monitoring and control. Available for use in a stand-alone version or with an interface to the DEC PDP-11; Compatibility with the Wyle line of printed circuit logic cards, power supplies, card files and accessories. User designed logic can be implemented in the same card file with the microcomputer system.

For further information contact Wyle Computer Products, 3200 Magruder Blvd., Hampton, VA 23666; (804) 838-0122.

CIRCLE INQUIRY NO. 218

Sol PC for Computer or Intelligent **Terminal Use**

Sol Terminal Computer, the new unit with all memory and interface electronics including video display, keyboard interface, audio cassette interface, all necessary software plus the ability to accept the Processor Technology line of memory and interface modules sells for \$475 in kit form.



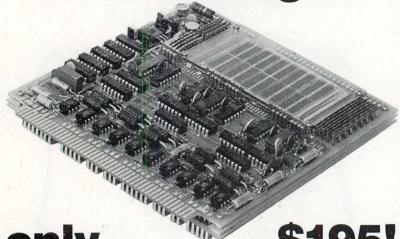
The Sol can be used as a microcomputer, low cost CRT terminal, and editing terminal. Built around the 8080 microprocessor, the Sol terminal consists of a PC assembly with the microprocessor, 512 eight-bit bytes of PROM on a plug-in personality module, 2048 eight-bit words of RAM, a 1024 character video display generator, keyboard interface, serial and parallel interfaces for connection to external devices and an edge connector for memory expansion. Optional extras include a power supply, video monitor, ASCII keyboard and case. Other options are a floppy disk system, high speed papertape reader, PROM programmer and color graphics

Because the Sol uses the 8080, memory can be expanded to 65k bytes. The Sol is completely compatible with Imsai, Altair and other S-100

Delivery is stock to 45 days after receipt of order. For more information, please address Processor Technology, 6200 Hollis Street, Emeryville, CA 94608; Phone (415) 652-8080.

CIRCLE INQUIRY NO. 219





Model 620 Core Memory System

- 1024 words x 10 bits
- Access time 350 nsec
- Full cycle 1.0 usec
- Reliable, field proved
- Single board, 6.0" x 6.4" on 1.0" centers

of logic levels

- Non-volatile
- Mating connector included
- Compatible with wide range Technical manual included
 - Delivery 10 days

FABRIETEK INC. COMPUTER SYSTEMS

5901 South County Road 18 • Minneapolis, MN 55436 • (612) 935-8811

Rush Order Form

Model 620 Core Memory System, \$195 postpaid in continental USA

Enclosed is my □ cashier's check □ money order □ personal check □ BankAmericard No.

Expires ☐ Master Charge No: _

Name Address

City State Zip Phone

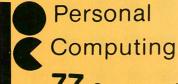
Deal



What its all about!

Software Development Micro Computers Hardware Development **Disc Memories** Computer Comparisons Interfacing Program Implementation **AMSAT** Computerized Music Video Terminals Kit Construction **Printers** Computer Games **Digital Tapes**

- Seminars and Technical talks by leading electronic equipment manufacturers
- Major Exhibits from all over the country
- Demonstrations in many areas including Home and Personal Computing
- Door Prizes, Free Literature and Free Mementos
- All this plus Sun and Surf Fun and Excitement Relaxation and Leisure



SPECIAL GROUP RATES FOR CLUBS AND ORGANIZATIONS TRAVELING FROM THE WEST COAST AND MID-AMERICA.

CONTACT Dawn Corrigan (213) 924-8383

Seven Seas Travel 17220 S. Norwalk Blvd. Cerritos, CA. 90701

Write for FREE TRIP-KIT to PERSONAL COMPUTING 77, Rt 1, Box 242, Mays Landing, New Jersey 08330

77 Consumer Trade Fair

EXHIBITION BOOTHS STILL AVAILABLE - CALL (609) 653-1188

HOPE

The most beautiful word in the world ... and a Project to go with it.



Dept. A, Washington, D. C. 20007

6000 Microcomputer

A new microcomputer system has been introduced by CGRS MICROTECH, Southampton, Pa. The "6000 MICROPUTER" is a new kind of microcomputer system with unparalleled flexibility. It uses the standard small computer bus structure and offers a select combination of features. A simple LEVEL I tutorial board can be easily expanded into a powerful microcomputer. The MICROPUTER system is set apart by the following two distinct features:

The LEVEL I MICROPUTER is a three-board hobbyist system consisting of the Static Control Panel, the MPU-I board and the mother-board. The MPU-I board contains the "6502" microprocessor and 256-byte static RAM. This combination allows the user to execute programs, to single-step through programs, and to learn how the microcomputer works. The LEVEL I MICROPUTER provides the user an inexpensive introduction to the microcomputers.

The LEVEL II MICROPUTER is a basic microcomputer system consisting of the Static Control Panel, the MPU-II board and the mother-board. The MPU-II board contains the "6502" micro-

processor, the 2K-byte static RAM, room for 1K-byte "1702" type EROM, the slow memory interface logic, and fully buffered bus lines. The LEVEL II system can be built from the LEVEL I system by simply adding the additional components. This system can be used as a base for a powerful microcomputer system.

The MICROPUTER system are available either in kit form or fully assembled. The delivery is within 3 weeks after receiving the order.

For further information contact CGRS Microtech, P.O. Box 368, Southhampton, PA 18966.

CIRCLE INQUIRY NO. 220

Altair BASIC Expands Computing Features

Altair BASIC's powerful features make it the most innovative and easy-to-use microcomputer language available.

8K Altair BASIC handles numeric and alphanumeric string data with a full range of arithmetic and string processing functions. The cassette version allows data and program files to be saved on cassette tape. Assembly language subroutines are easily interfaced by byte-oriented memory and I/O instructions.

Extended Altair BASIC adds a more complete range of arithmetic and logical operations. It provides a PRINT USING statement for formatted output, a powerful EDIT command for program development and debugging and automatic line numbering and renumbering. Extended statements and commands include: IF ... THEN ... ELSE, LIST and DELETE program lines, SWAP variables and Trace On and Off for debugging.

Disk Altair BASIC supports sequential and random access disk files. File maintenance utilities are included in the system.

utilities are included in the system.
For further information contact MITS, 2450
Alamo S.E., Albuquerque, NM 87106.

CIRCLE INQUIRY NO. 221

SOL-20

A complete computer featuring input/output devices and interfaces, memory, software and keyboard designated the Sol-20, is said to include more standard attributes than any other small computer on the market today. Included in the package are an 8080 microprocessor, 1024 character video display circuit, 1024 words of static low-power RAM, 1024 words of preprogrammed PROM and a custom 85-key solid-state keyboard.



Other features are an audio cassette interface capable of controlling two recorders at 1200 baud, parallel and serial standardized interface connectors, a complete power supply including fan and a contemporary cabinet with solid walnut sides.

Software includes a PROM personality module and a cassette with BASIC-5 language plus two sophisticated computer video games. The Sol-20 works with all S-100 bus products including those of Altair, Imsai and Processor Technology.

Heart of the Sol-20, the Sol all on one board PC kit is also available for \$475.

For more information and a copy of our new 22 page catalog, please address Processor Technology Corp., 6200 Hollis Street, Emeryville, CA 94608; Telephone (415) 652-8080.

CIRCLE INQUIRY NO. 222

The Affordable CRT Terminal

\$525 complete with high resolution 9" monitor · \$400 without · Horizontal cursor control and bell · \$50 • INCLUDED FEATURES:



- 64 characters by 16 lines
- Auto Scrolling
- Underline Cursor
- RS232C or Current Loop
- Data Rates of 110,300,600, 1200, 2400, 4800, and 9600 baud are jumper selectable
- All oscillators (horiz., vert., baud rate, and dot size are crystal controlled

The ACT-1 is a complete teletype replacement compatible

with any processor which supports a serial I/O port. Completely assembled and dynamically tested.

VIDEO TERMINAL BOARD • \$250 • The same circuitry as used in the ACT-1 on a single 8 ½ "x 11" board. The VTB is assembled, tested and comes complete with power supply. Add your own parallel data keyboard and monitor to produce a complete serial 1/0 video terminal. Available – Dec. 1 •

MICRO-TERM INC. P.O. BOX 9387 ST. LOUIS, MO. 63117

(314) 645-3656

Prices

FOB St. Louis

BankAmericard

Mastercharge



MICROPROCESSOR BOOKS



FROM OSBORNE & ASSOCIATES, INC.

Since we published our first AN INTRODUCTION TO MICROCOMPUTERS in December, 1975, our books on microprocessors have dominated this market place, becoming the standard texts and reference books for the industry. Sales of our three current titles total fifteen thousand books per month and we have had more than three hundred university text adoptions.

These are our current texts:

AN INTRODUCTION TO MICROCOMPUTERS: VOLUMES I AND II

VOLUME I — BASIC CONCEPTS takes you by the hand, from elementary logic and simple binary arithmetic through the concepts which are shared by all microcomputers. It tells you how to take an idea that may need a microcomputer and create a product that uses one. This book is complete — every aspect of microcomputers is covered: the logic devices that constitute a microcomputer system; communicating with external logic via interrupts, direct memory access, and serial or parallel I/O; microprogramming and macroprogramming; assemblers and assembler directives; linking and relocation — everything you need to know if you are going to select or use a microcomputer. Approximately 400 pages. Order publication number 2001. Price: \$7.50.

VOLUME II — SOME REAL PRODUCTS covers real microcomputers, in considerable detail. Every major microcomputer: 4-bit, 8-bit or 16-bit, is described, including some soon to be announced products. Major chip slice products are also covered. More than 20 microcomputers in all. Approximately 900 pages. Order publication number 3001. Price: \$12.50.

8080 PROGRAMMING FOR LOGIC DESIGN AND 6800 PROGRAMMING FOR LOGIC DESIGN

These are completely new books on a totally new subject: implementing digital and combinatorial logic using assembly language within an 8080 or 6800 microcomputer system. What happens to fan-in and fan-out? How do you implement a one-shot? These books simulate well known digital logic devices using assembly language; next they show you how to simulate an entire schematic, device by device, keeping the assembly language simulation as close to the digital logic as possible. But that is the wrong way to use a microcomputer; these books explain why, then show you the correct way. These books describe the meeting ground of programmer and logic designer; they are written for both readers. Approximately 300 pages each. Order publication number 4001 (8080) or 5001 (6800). Price: \$7.50 each.

For ordering and pricing information please contact (or use form below):

OSBORNE & ASSOCIATES, INC.

P.O. Box 2036 • Berkeley, California 94702

• (415) 548-2805

Foreign orders from Europe, Japan, Western Canada, Taiwan and Israel will be forwarded to the local distributor. All other foreign orders should include \$3.00 airmail, \$0.50 surface mail shipping charges per book.

· BOOK ORDER FORM ·

			Check or Money Order enclosed.	
TITLE	UNIT PRICE	QUANTITY	Purchase Order enclosed (we will	only invoice for orders over ten).
Volume I—Basic Concepts (#2001)	\$7.50 ea.		I require information on consignm	ents, discounts and for
Volume II—Some Real Products (#3001)	\$12.50 ea.		distributors outside the U.S.A.	
8080 Programming For Logic Design (#4001)	\$7.50 ea.		BankAmericard No.	Exp. Date
M6800 Programming For Logic Design (#5001)	\$7.50 ea.		Master Charge No.	Exp. Date
Include appropriate sales tax for California residents.			Signature:	
NAME				
ADDRESS				
CITY, STATE and ZIP			TELEPHONE	
COMPANY		Ir	which publication did you see our ad?	

Price includes 4th class mail delivery within the U.S. in 3-4 weeks. For faster delivery include \$1.50 extra per book for shipping and handling. Shipping charges for bulk orders of \$750.00 or more, retail value, to be arranged.



It was only logical that the people who build logic analyzers would choose to clip onto DIP's with our IC Test Clips. There's nothing faster and easier, nothing better.

And it was only logical that these same people would ask for Great Jumpers — our fully pre-assembled and fully pre-tested flat ribbon cable/connector assemblies — to make the jump from outboard to on.

The Logical Connection. Our name for this exciting test clip jumper assembly. And your name for the answer you've been looking for.

The Logical Connection's available in standard configurations from our stocking distributors. Or ask the man from A P to explain how we can make The Logical Connection for you.

Our distributor list is growing daily. For the name of the distributor nearest you call Toll-Free 800-321-9668.



Send for our complete A P catalog, The Faster and Easier Book.

AP PRODUCTS INCORPORATED

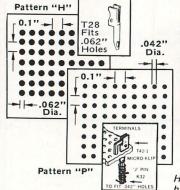
Box 110-E Painesville, OH 44077 (216) 354-2101

CIRCLE INQUIRY NO. 38

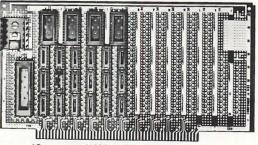
VECTORBORD® TENTH/TENTH HOLES MOUNT:

DIPS, SIPS, KLIPS, CHIPS PINS, POSTS, POTS, PADS RCs, ICs, PCs, SCs

Save Work — Time — Money



8800V MICROPROCESSOR PLUGBORD



(Component Side with Added Sockets)

Has 100 contacts on 0.1" centers, is 10" wide by 5.313" high. Has heavy tinned back-to-back buses, overall 0.1" spaced 0.042" hole pattern. Socketed models available.

WIDE SELECTION OF SIZES AND MATERIALS

MICRO-VECTORBORD $^{\circ}$ "P" -0.042" holes match DIP leads. Epoxy glass, or glass composite, paper, copper clad. Also 1/64" to 1/16" thick and 10" max. width.

VECTORBORD "H" — For larger terminals, leads. Available in epoxy glass sheets 4.8" to 8.5" wide and 8.5" to 17" long. 1/32" and 1/16" thick.

TERMINALS — Complete selection of wire wrappable and solderable push-in terminals for 0.042" and 0.062" dia. holes — plus wiring tools available.

PLUGBORDS — For solder or wrap wire construction 2.73" to 10" wide and 4.5" to 9,6" long. With holes .1"x .1", .1"x .2", .2"x .2", or loaded with IC sockets.

Vector

Send for complete literature

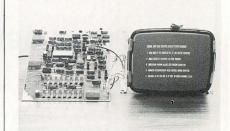
ELECTRONIC COMPANY, INC. 12460 Gladstone Ave., Sylmar CA 91342 (213) 365-9661 — TWX (910) 496-1539



CIRCLE INQUIRY NO. 39

A Complete Computer System Board For Only \$325

The 2650 Computer System offers a complete computer system on a single circuit board. You receive: an 80 character by 16 line video generator, a keyboard interface, a 300 baud cassette interface, 768 bytes of user RAM, and a powerful supervisor program.



The board comes completely assembled and tested with a one-year guarantee. The only power supply required is 5v at 3a. Other equipment that is needed to get your full system up is just a video monitor, an ASCII keyboard, and an audio cassette tape recorder.

An assembler/editor package is available, and a basic interpreter will be available shortly. The supervisor program provided allows alter or display of memory, execution of user programs, setting and learing of breakpoints, inspecting and altering the CPU's registers, dumping to and loading from tape, and verifying a tape's contents. The assembler/editor and basic packages can be purchased for \$20, which includes a cassette tape and a listing.

The microprocessor used in the system is the Signetics 2650.

For further information contact Central Data Company, P.O. Box 2484, Station A, Champaign, IL 61820.

CIRCLE INQUIRY NO. 223

Microcomputer Kits For Personal Computer Builders

Three kits are available, the EVK 99, EVK 100 and the top of the line EVK 200, and a completely assembled version, the EVK 300. The top of the line EVK 200 is a complete microcomputer system containing all necessary components for complete construction, including a pre-programmed ROM for system monitor and general software utilities. All that are required for operation are a power supply and suitable I/O devices (TTY, CRT or modem). Level conversion circuitry, baud rate generation and adjustability are included on the basic board.

The EVK series are inexpensive high performance systems that are ideal for first time users of microcomputers. The kits, used as evaluation boards by OEMs of processing and manufacturing equipment, can provide first time builders with not only a personal computer, but the opportunity to gain familiarity with individual devices and recommended applications circuitry.

The AMI EVK kits are packaged on 10½" by 12" PC boards with two 86 pin edge connectors, one for the microprocessing unit bus lines and one for I/O. The finished board thickness is about 564"

The central processor for all is the AMI S6800 8-bit chip, with an instruction execution time of 2 tact sec and memory access time of 575 ns maximum. Memory in the EVK 200 includes 2K bytes of dedicated ROM which contain software pertinent to the system monitor, 1024 bytes of RAM, and 2K bytes of EPROM.

For further information contact Mr. Tom Edel, American Microsystems, Inc., 3800 Homestead Road, Santa Clara, CA 95051. (408) 246-0330.

BASIC

The handle for the tool.

A microcomputer without software is a tool without a handle. PolyMorphic systems BASIC is the handle on the POLY 88; this provides the interface between user and computer. Our BASIC fits the POLY 88 like a finely balanced handle fits a quality tool. PolyMorphic Systems Basic is an extremely efficient way to program. It makes possible the immediate use of the POLY 88 for a wide range of engineering, scientific and general problem solving. In conjunction with either System 7 or System 16 PolyMorphic Systems BASIC is the reliable and ready to go microcomputer tool on the market.

No more waiting for the long-promised software system. Among our best BASIC features: graphic plotting function, tape save and dump with named files, time function, and self-explanatory error messages. We believe the best tool — the POLY 88 — must have the best handle: PolyMorphic Systems BASIC.

MARCH 1977

Polymorphic Systems 11K BASIC

Size: 11K bytes. Scientific Functions: Sine, cosine, log, exponential, square root,

Scientific Functions: Sine, cosine, log, exponential, square root, random number, x to the y power.

Formatted Output • Multi-line Function Definition • String Manipulation and String Functions • Real-Time Clock • Point-Cassette Save and Load of Named Programs • Multiple Statements per Line • Renumber • Memory Load and Store • 8080 Input and Output • If Then Else • Input type — ahead Commands: RUN, LIST, SCR, CLEAR, REN, CONT

Statements: LET, IF, THEN, ELSE, FOR, NEXT, GOTO, ON, EXIT, STOP, END, REM, READ, DATA, RESTORE, INPUT, GOSUB, RETURN, PRINT, FILL, OUT.

Built in Functions: FREE, ABS, SGN, INT, LEN, CHR\$, VAL, STR\$. ASC, SIN, COS, RND, LOG, TIME, WAIT, EXP, SORT, CALL, EXAM, INP. PLOT.

Systems Available. The POLY 88 is available in either the kit or assembled form. It is suggested that kits be attempted only by persons familiar with digital circuitry. The following is a list of the

System 1: is a kit and consists of the Poly 88 chassis, CPU and video circuit cards only. Requires keyboard and TV monitor for operation, \$595.

System 2: Consists of System 1 with the addition of the cassette interface circuitry-requires cassette recorder. \$690.

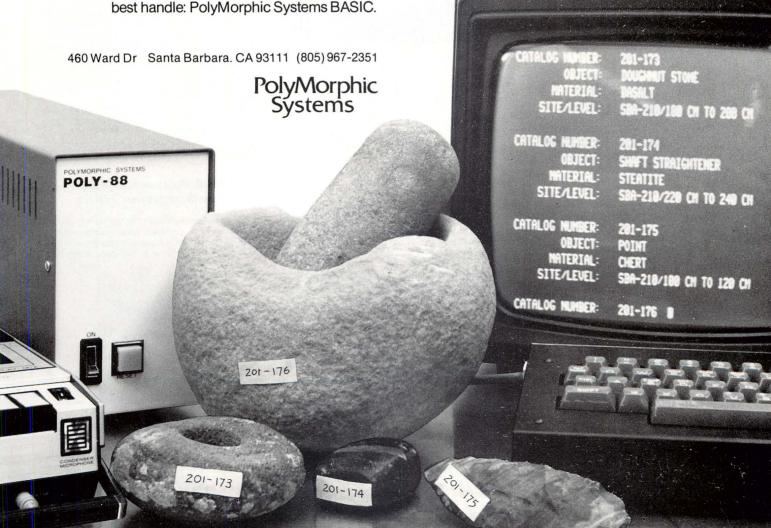
System 3: System 2 with 8K memory card, BASIC and assembler cassette tapes. \$990.

System 4: Also a kit, but containing in addition to System 3 a keyboard, cassette deck and TV monitor, \$1350.

System 7: Consists of an assembled and tested POLY 88 with 8K of memory, keyboard, TV monitor, cassette recorder, 8K BASIC and Assembler cassette tapes. \$1750.

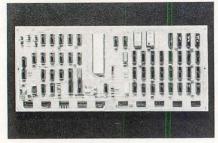
System 16: Consists of an assembled and tested POLY 88 with 16K of memory, keyboard, TV monitor, cassette recorder, 11K BASIC and Assembler cassette tapes. \$1995.

NTERFACE AGE 59



Super Starter System TEC 9900-SS

The Texas Instruments introduces TMS 9900 16-bit Microprocessor. The TI Chip has Hardware multiply and divide and separate Data and Address Buses.



The Technico 7" x 16" P-C Board has capacity for 2K Bytes each of RAM, PROM, and E-PROM and includes a monitor and E-PROM programmer on Board as well as an adjustable RS232 or 20 ma loop. Provision is also made for programming in assembly language with an On-Board Input Assembler.

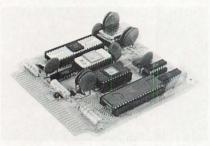
IO Boards and Memory Add-On Boards expandable up to 65K Bytes. Basic operating system as low as \$299 unassembled and \$399 assembled.

For further information contact Technico, Inc., 9130 Red Branch Road, Columbia, MD 21045; (301) 461-2200 or 1-800-638-2893.

CIRCLE INQUIRY NO. 225

TPU/1 Data Processing System

The TPU/1 is a powerful data processing system that can be tailored to fulfill a variety of application needs at lowest possible cost. The system is expandable up to 32K memory and/or almost infinite I/O ports.



M6800 MPU is the central processing unit which controls the overall operation of the system. Its function includes carrying out the execution of software instructions, handling interrupts, buffering information in its internal registers, etc. The ROM and the RAM is the memory portion of the system. The ROM is primarily for storing system software (the computer programs) while the RAM is for storing general data. The PIA (Peripheral Interface Adapter) provides channels between the MPU and the I/O devices such as Keyboards, teletypes, or process controllers.

For further information contact Sphere Corporation, 940 N. 400 East, North Salt Lake, UT 84054; (801) 292-8466.

CIRCLE INQUIRY NO. 226

The Familiarizor

The Familiarizor, an eight bit microcomputer, consists of a hexidecimal keyboard and display mounted on a single printed circuit board. With the addition of a power supply, it becomes a complete simple to operate microcomputer. The unit is used in conjunction with self teaching Hardware and Software manuals to give the beginner practical low cost "Hands-On" experience with microprocessors.

At the heart of the Familiarizor is MOS Technology's 6502 microprocessor which can

address up to 65K bytes of memory. On board also are 1K bytes of RAM for user programs. A 256 byte monitor program is provided in one 1702A PROM. For those who wish to store their own programs in PROM, provisions have been made for three additional 1702A's. The monitor program and an on board terminal, (as opposed to lights and switches,) make loading, running, debugging, and modifying programs easy.

The Familiarizor is available in kit form with complete instructions for \$229.00, including hardware and software manuals, all parts, circuit board and complete documentation. The assembled model is available for \$285.00 Power supply is optional at \$58.00.

For further information contact EBKA Industries, 6920 Melrose Lane, Oklahoma City, OK 73127.

CIRCLE INQUIRY NO. 227

The Data Handler

The Data Handler is a complete microcomputer system on a single printed circuit board designed around the Mos Technology 6502 microprocessor.

This complete microcomputer system contains 1K bytes of random access memory, one eight bit parallel input port with data latch and interrupt strobe, and one eight bit parallel output port with clearable data flag.



The Data Handler contains a 26 keyboard switch hardware controlled front panel which will load data, examine data, perform single cycle and single instruction, initialize the system, run and halt the system all in hexidecimal format.

For further information contact Western Data Systems, 3650 Charles Street, Suite G, Santa Clara, CA 95050; (408) 984-7804.

CIRCLE INQUIRY NO. 90

Super Jolt

SUPER JOLT, single board computer, measures a mere 4¼" by 7" and contains the 8 bit 6502 microprocessor, 1,024 bytes static RAM, 32 bidirectional and programmable I/O lines, a 1 megahertz crystal controlled clock, an interval timer, 4 interrupts including a timer interrupt and a non-maskable interrupt, three serial interfaces: 20 ma current loop, RS 232 and TTL, as well as 5,120 bytes of resident ROM program memory that includes a complete single pass Resident Assembler Program called RAP, a resident TINY BASIC interpretive language designed especially for JOLT systems and the 1,024 byte DEMON DEBUg MONitor program.

SUPER JOLT is further supported by a complete family of existing JOLT card modules including 4K RAM, 2K 1702A PROM, Input/Output, Power supply and Universal Card. A five slot card cage and an 8080 CPU card module substitute are also available. Soon to be announced are the A/D, D/A card and the cassette interface card.

Single unit pricing for the SUPER JOLT card, fully assembled and tested is \$375 without RAP and TINY BASIC ROMs, and \$575 with the ROMs. Quantity discounts are also available. Prices of other JOLT cards, in kit form begin as low as \$96.

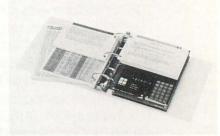
For further information contact Microcomputer Associates Inc., 2589 Scott Boulevard, Santa Clara, CA 95050; (408) 247-8940.

CIRCLE INQUIRY NO. 91

IASIS Announces the First Computer in a Book

lasis Inc., has combined an operational 8080 based Microcomputer system and a 250-page programming course into a standard three ring binder.

The ia7301 Computer in a Book was designed to serve initially as an instructional course for hobbyists and engineers who want to become proficient in programming microcomputer systems. Once the user has mastered programming the system he can expand and adapt the system to a wide variety of applications for industry, for business and for the home. Compatible expansion books and interface cards are available from lasis to increase the systems memory from 1K bytes of RAM to 64K bytes and from 2 I/O ports to 256 ports. Other interface cards, soon to be available, will drive CRT displays, full keyboards and floppy disks.



Of particular interest to the experimenter or hobbyist is the special cassette tape interface built into the Computer in a Book. The user can retain and store parts or entire programs by hooking the Computer in a Book up to most any home cassette tape recorder. The ia7301 Computer in a Book is fully assembled and tested. A hexadecimal conversion card and machine language coding pad are included in the binder. The ia7301 uses a dual voltage (+5V; +12V) supply: the -5V is generated internally. All interfaces are made through the 28 pin top edge connector. Delivery is four weeks and the complete Computer in a Book sells for \$450 in 1-5 quantities.

For further information contact 815 West Maude Ave., Sunnyvale, CA 94086; (408) 732-5700.

CIRCLE INQUIRY NO. 92

Small, Pre-assembled Module Aids Microprocessor Learning

Texas Instruments Incorporated today announced a pre-assembled microprocessor "learning module" priced comparable to do-it-yourself kits, including a 160-page instruction manual



The entire module sells for \$149.95 (1 to 9 quantities). It was developed by a team of TI microprocessor experts and members of the academic community to teach basic microprogramming and machine code concepts — primarily the difficult to grasp relationship between software and hardware.

For further information contact Texas Instruments, Inc., P.O. Box 5012, Dallas, TX 75222.

DIGITAL DATA RECORDERS



MODEL 3M3 \$199.95

(Price Increases to \$220.00 effective 1 April 77)

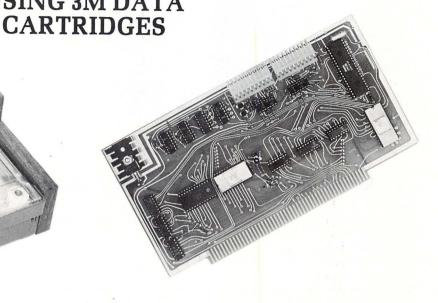
Featuring the radically new "Uniboard" method of construction for data cartridge drives. The major computer makers are changing to cartridges at a rapid pace because of the freedom from binding and greater data reliability. Operates in the phase encoded self-clocking mode which provides greatly enhanced freedom from speed variation problems and allows 100% tape interchangeability between units.

Uses the 3M Data Cartridge, model DC 300. This cartridge contains 300 feet of .250 tape in a sealed plastic container. Using four tracks you can record nearly 2 megabytes of data on a cartridge.

Specifications: Full software control of record, play, fast forward and rewind. LED indicates inter-record gaps. EOT and BOT are sensed and automatically shut down recorder. Feedback signals send reset and interrecord gap signals back to the computer so that software searching for inter-record gaps at high speed can be accomplished. Can also be operated manually by means of the switches on top which parallel the software control signals. \$199.95 until April 1, 77. \$220.00 after April 1, 77. Includes Phase Encoder Board (ACI).

For 8080, 8085, and Z-80 users:

Comes complete with software listing for the programs in the 2SIO(R) ROMs. Can be controlled by any of the commonly used I/O boards. Send for complete documentation and interfacing instru 3M3 and 2SIO(R) (\$3.00). These programs provide full software control.



2SIO(R) CONTROLLER \$190.00

2SIO(R) CONTROLLER (Bootstrap Eliminator)

This is a complete 8080, 8085, or Z80 system controller. It provides the terminal I/O (RS232, 20 ma:, or TTL) and the data cartridge I/O, plus the motor controlling parallel I/O latches. One kilobyte of on board ROM provides turn on and go control of your Altair or Imsai. No more bootstrapping. Loads and Dumps memory in Hex on the terminal, formats tape cartridge files, has word processing and paper tape routines. Best of all, it has the search routines to locate files and records by means of six, five and four letter strings. Just type in the file name and the recorder and software do the rest. Can be used in the BiSync (IBM), BiPhase (Phase Encoded) or NRZ modes with suitable recorders and interfaces.

\$190, wired and tested.

\$160, Kit form.

Audio Cassette Interface (ACI) This is the phase encoding board used in the 3M3. Additional components on the board enable you to use audio recorders in the KC standard or the new PE 2400 (2400 baud) systems. Can also be used for Tarbell if you have an 8251 Intel I/O chip. Required if you use an audio cassette with the 2SIO(R) above.

\$55, wired and tested. \$35, Kit form.

For 6800 Users: Software programs and I/O board for SWTP are under development. Limited software available now. Ask for 6800 data with \$3.00 Documentation package. These programs will provide full software control.

CARTRIDGE AVAILABILITY: Cartridges are made by 3M, ITC, Wabash and others. They are available at all computer supply houses and most major computer service centers. We can supply them at normal current list prices.

"COMPUTER AID" and "UNIBOARD" are trademarks of the NATIONAL MULTIPLEX CORPORATION. The 3M Data Cartridges are covered by 3M Patents and Marks. "UNIBOARD" Patents Pending.

OVERSEAS: EXPORT VERSION — 220 V — 50 Hz. Write Factory or: Megatron, 8011 Putzbrunn, Munchen, Germany; Nippon Automation 5-16-7 Shiba, Minato-Ku, Tokyo; Hobby Data, FACK 20012 Malmo, Sweden; G. Ashbee, 172 Ifield Road, London SW 10-9 AG.

For U.P.S. delivery, add \$3.00. Overseas and air shipments charges collect. N.J. Residents add 5% Sales Tax. WRITE or CALL for further information. Phone Orders on Master Charge and BankAmericard accepted.

NATIONAL MULTIPLEX CORPORATION

3474 Rand Avenue, South Plainfield NJ 07080, Box 288, Phone (201) 561-3600 TWX 710-997-9530

If you want a microcomputer with all of these standard features...

- 8080 MPU (The one with growing software support) 1024 Byte ROM (With maximum capacity of 4K Bytes)
 • 1024 Byte RAM (With maximum capacity of 2K
- Bytes)
 TTY Serial I/O • EIA Serial I/O 3 parallel I/O's
 ASCII/Baudot
- terminal compatibility with TTY machines or video units Monitor having load, dump, display, insert



Complete with card connectors

• Comprehensive User's Manual, plus Intel 8080 User's Manual

Completely factory assembled and tested-not a kit • Optional ac-

cessories: Keyboard/video display, audio cassette modem

interface, power supply, ROM programmer .plus more options and attractive cabinetry. to follow. The HAL MCEM-8080. \$375

...then let us send you our card.

HAL Communications Corp. has been a leader in digital communications for over half a decade. The MCEM-8080 microcomputer shows just how far this leadership has taken us...and how far it can take you in your applications. That's why we'd like to send you our card-one PC board that we feel is the

best-valued, most complete

microcomputer you can buy. For details on the MCEM-8080, write today. We'll also include comprehensive information on the HAL DS-3000 KSR microprocessorbased terminal, the terminal that gives you multi-code compati-

bility, flexibility for future changes, editing, and a convenient, large video display format.

HAL Communications Corp. Box 365, 807 E. Green Street, Urbana, Illinois 61801 Telephone (217) 367-7373

POLY 88 System Sixteen

Completely integrated and functional, the POLY 88 System Sixteen comes with a fully extended 11K BASIC and all the peripherals necessary to begin programming.



Special features of the BASIC include graphics, real time clock, and tape save and load of named programs. The capabilities of the 11K BASIC utilize important features engineered into the compact POLY 88 hardware, such as vectored interrupt and real time clock. The S100 compatible chassis supports a central processor unit, video terminal interface, Byte/Polyphase cassette interface mini-card and 16K RAM. A 1K monitor ROM provides bootstrap, debug, and single step capability. The cassette recorder, keyboard, and TV monitor provide quick and convenient interaction between the user and the computer. Fully assembled and tested, the System Sixteen is at the command of your fingertips the moment it's unpacked. \$1995.

For further information contact PolyMorphic Systems, 460 Ward Drive, Santa Barbara, CA

CIRCLE INQUIRY NO. 94

1702A MANUAL EPROM PROGRAMMER

bit data drivers/receivers. Two 61/2" x 9" stacked cards with

in 20 minutes

Features hex keypad, two digit hex address and two digit hex data display. Con-

trols include load, clear, go! (step), key/copy, data in/

data out, and counter up/ down. Profile card includes

high voltage pulse regulator,

timing, 8 bit address and 8

fabulous Phi-Deck family of 5 cassette transports under \$100 in quantities of 10



Featuring:

- Die-cast frames
- · Remote controllable
- · Precise fast head engage/disengage

Electron

- 1. Micro
- 2. Data

Address

City

- record
- 3. Progr
- 4. Instru
- 5. Indus
- 6. RS23

• Quick braking • FF/rewind 120 ips • Speed ranges from .4 to 20 ips	5 minutes. Requires +5, -9, and +80 volts. ASSEMBLED
Rectronic packages and mag heads for most applications For application in: 1. Micro processing 2. Data	The best of two worlds use our 1702 EPROM programmer as a manual data/address entry programmer or connect it to your processor. IMSAI/ALTAIR computer interface (requires 3 output ports, +1 input port) and software
Tiple A Division of the Economy Co. 4605 N. Stiles P.O. Box 25308 Oklahoma City, Oklahoma 73125 (405) 521-9000 I am interested in application no. Have Representative call Send application notes Name Title	low power RAM. All memory chips socketed. Uses all prime, factory fresh ICs. High quality, two-sided, through-hole-plated circuit board. Crystal controlled, totally invisible refresh system requires NO software management. Just plug it in and use like STATIC memory. Complete kit
Name	12444 Lambert Circle • Garden Grove, CA 92641

CIRCLE INQUIRY NO. 42

(714) 539-0735

Zip

Phone Number

Company Name

IF YOU'RE STILL PLAYING GAMES IT'S BECAUSE YOU HAVEN'T SEEN **OUR SOFTWARE LIBRARY**



This BASIC SOFTWARE LIBRARY is a complete do it yourself kit. Written in everybodys BASIC immediately executable in ANY computer with at least 4K, no other peripherals needed. Over 1000 pages of source codes, descriptions and instructions.

** Also available at most computer stores **

This library is the most comprehensive work done of its kind to date. There are other software books on the market today but they are dedicated to computer games. The intention of this work is to allow the average individual the capability to easily perform useful and productive tasks with a computer. All of the programs contained within this Library have been thoroughly tested and executed on several systems. Included with each program is a description of the program, a list of potential users, instructions for execution and possible limitations that may arise when running it on various systems. Listed in the limitations section is the amount of memory that is required to store and execute the program in K Bytes.

Your Library is Waiting

The much requested Volumes III & IV are ready. If you already have Volumes I and II you'll want to add these to your set. With the addition of Volume IV there is no reason why anyone who even THINKS of using a computer can't own their own SOFTWARE LIBRARY. You can start yours for less than \$10 plus postage and handling. These programs are IMMEDIATELY executable in ANY computer with at least 4K. The entire Library is 1000 pages long, chocked Full of Program source code, instructions, conversions, memory requirements, examples and much more. ALL are written in compatible BASIC executable in 4K MITS, SPHERE, IMS, SWTPC, PDP, etc. BASIC compilers available for 8080 & 6800 under \$10 elsewhere.

> VOLUME I & II - \$24.95 each - \$39.95 each **VOLUME III VOLUME IV** - \$ 9.95 each

add \$1.50 per volume for postage and handling

Volume discounts are available to qualified users & dealers.

Personal checks — allow 4 weeks for shipping. Pricing subject to change without notice. If air mail shipping desired add \$3 per volume to price, Continental U.S. only. Foreign orders add \$8 for each volume.



RANKAMERICARD

welcome here

SCIENTIFIC RESEARCH

1712-I FARMINGTON COURT CROFTON, MD 21114



PHONES ORDERS CALL (800) 638-9194

INFORMATION and MARYLAND RESIDENTS CALL (301) 721-1148

PLOTTING & STAT Binomial Chi-Sq. Confidence 1 Confidence 2 Correlations Curve Differences Exp Distri Least Squares Paired Plot Plotpts Polynomial Fit Regression Stat 1 Stat 2 T-Distribution Unpaired Variance 2

APPENDIX A
BASIC STATEMENT DEF

VOLUME THREE

Part 5

ADVANCED BUSINESS Billing Inventory Pavroll Risk Schedule 2 Shipping Stocks Switch

VOLUME FOUR GENERAL PURPOSE PROGRAMS Bingo Bonds Bull Enterprise Football Funds 1 Funds 2 Jack Life Loans Mazes Poker Popul Profits Qubic Rates Retire Savings SBA Tic-Tac-Toe

Rand 1

Efficient

Interest Investments

Mortgage Optimize

Order Pert Tree

Rate

Return1

Return 2

Part 2 GAMES

Bagel Bio Cycle Cannons

Schedule 1

Animals Four

Astronaut

Checkers

Craps Dogfight Golf

Judy

Line Up

Pony Roulette

Sky Diver

Teach Me

PICTURES

A. Newman J.F.K.

Linus Ms. Santa

Noel Noel

Policeman

Snoopy

Part 3

Beam Conv. Filter

Lola

Macro

Optical Planet

Max. Min. Navaid

Integration 1

Integration 2 Intensity

Santa's Sleigh

VOLUME TWO

MATH & ENGINEERING

Nixon

Nude

Installment

Flow

COMPAL 80 Microcomputer System

The COMPAL-80 computer is a microprocessor based machine which may be used as a high performance desk-top computer; as an "intelligent terminal" within a large time-sharing system; or as the basis of an expanded system for business data processing, word processing, or microcomputer software development.



The basic machine includes: power supply and S100 motherboard, 8080A mP, real time clock, vectored interrupt decoder, ROM system monitor, 16K static RAM, RS-232 and current loop serial I/O interface, 300/2400 baud cassette interface, 16 lines x 64 character video display (full ASCII plus 48 x 128 graphics mode), capacitance switch keyboard, 9" video monitor, and beautiful matching cabinets. Total price, assembled and tested, is \$2300.

For further information contact Computer Power & Light, Inc., 12321 Ventura Blvd., Studio City, CA 91604; (213) 760-0405.

CIRCLE INQUIRY NO. 95

The OSI Challenger

The OSI Challenger is the first fully assembled mainframe computer which is priced competitively with hobby kits.



This 8 slot table-top unit with UL approved power supply comes equipped in its smallest configuration of serial interface, IK RAM and PROM monitor for \$439. Video systems which do not require an expensive terminal, start at \$675.

The Challenger is now supported by thirteen accessory boards available bare, in kit form, and fully assembled. Challenger peripherals now include single and dual drive floppies, cassettes, a keyboard, and a video display unit. Software now includes an assembler, a small and a large BASIC, a disk operating system, an extended monitor, several games, and several real time analog and graphics packages.

For further information contact Ohio Scientific Instruments, 11679 Hayden St., Hiram, OH 44234; (216) 569-7945.

CIRCLE INQUIRY NO. 96

The Etcetera System

The ETCETERA System is a microprocessor tool for hobbyists and professionals interested in exploring and utilizing the technology of LSI Microprocessors. Like other commercially available microprocessor based systems, the ETCETERA System uses commercially available microprocessor circuits from companies such as Motorola, National Semiconductor, Intel, Fairchild, Texas Instrument and others as its

central processing elements. What distinguishes ETCETERA from other microprocessor-based computers is that it can accommodate a mix of different processors in a common system.

For further information contact ElectronicTool Co., 4736 W. El Segundo Bl., Hawthorne, CA 90250; (213) 644-0113.

CIRCLE INQUIRY NO. 97

Vector I Computer

Custom cabinet, 18 slot Motherboard S-100 Bus with 6 connectors, power supply 18A, 8V; 2A, $\pm 16V$, whisper fan, card supports and guides for 6 cards, all hardware, wire and solder. 8080 based CPU board with 8 level vectored priority interrupts, current status register, real time clock and dual mode.



PROM/RAM board with 1K RAM, room for 2K ROM type 1702A. 512 byte monitor for use with Tarbell cassette and Altair™, IMSAI, or Polymorphic I/O boards. The Vector 1 requires I/O board and terminal or video board, keyboard and monitor.

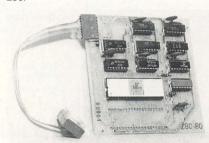
Price information: Vector 1 — kit \$619, assembled \$849; Vector 1 without PROM/RAM — kit \$519, assembled \$719; Vector 1 without CPU — kit \$499, assembled \$699; Vector 1 without CPU and PROM/RAM — kit \$349, assembled \$499.

For further information contact Vector Graphics Inc.™, 717 Lakefield Rd., Suite F, Westlake Village, CA 91361; (805) 497-0733.

CIRCLE INQUIRY NO. 98

Z-80 Piggy Back Card

Z80 power for the S-100 BUS without getting rid of your CPU card. Dutronics, a leader in low cost, low power RAM boards has just announced its Z80-80 piggy back card. This plug-in board enables you to use your existing IMSAI, ALTAIR, BYTE CPU card and upgrade your system to a Z80.



The card design is such that all you do is pull out your 8080 and 8212 chips, plug in the board to the 8080 socket itself and the ribbon cable to the 8212.

A system monitor, on paper tape, is included with the board as well as a Z80 manual and theory of operation. Dutronics will also supply all additional software at no cost, when it becomes available.

The price is \$159.95 (assembled) only, off the shelf.

For further information contact R.H.S. Marketing, 2233 El Camino Real, Palo Alto, CA 94306; (415) 321-6639.

CIRCLE INQUIRY NO. 99

The Compucolor 8001 Is Also Available Through The Following Authorized Distributors

Phoenix Byte Shop West 12654 North 28th Drive Phoenix, Arizona 85029 Alan P. Hald (602) 942-7300

Tempe Byte Shop East 813 N. Scottsdale Rd. Tempe, Arizona 85282 Alan P. Hald (602) 894-1129

Amco Electronics 414 South Bascom Ave. San Jose, Ca. 95128 Daniel Judd (408) 998-2828

Computer Components 5848 Sepulveda Blvd. Van Nuys, Ca. 91411 Dick Dickinson (213) 786-7411

The Computer Store 63 South Main Street Windsor Locks, Conn. 06096 George Gilpatrick (203) 627-0188

Sunny Computer Stores, Inc. University Shopping Center 1238A S. Dixie Highway Coral Gables, Fla. 33146 Bill Miller (305) 661-6042

MicroComputer Systems, Inc. 144 So. Dale Mabry Highway Tampa, Fla. 33609 Forrest K. Hurst (813) 879-4301

Atlanta Computer Mart 5091-B Buford Highway Atlanta, Ga. 30340 Jim Oxford (404) 455-0647

The Computer Mart of New Jersey 501 Route 27 Iselin, N.J. 08830 Larry Stein (201) 283-0600

> Byte Shop 2018 Greene St. Columbia, S.C. 29205 Nick Johnson (803) 771-7824

The Communications Center 7231 Fondren Houston, Texas 77036 Bill Tatroe (713) 774-9526

The Micro Store 634 S. Central Expressway Richardson, Texas 75080 David Wilson (214) 231-1096

Or Contact Us Direct

5965 Peachtree Corners East Norcross, Georgia 30071 Telephone (404) 449-5961

The Compucolor 8001 System.

It's A Stand Alone Micro Computer With Color Input/Output Capabilities All In One Package. For Only \$2995.

If you're looking for an input device, an output device and a micro computer all in one package, you've found it. The Compucolor 8001. It's here now, in color, on sale for only \$2995.

We gave it a memory of its own.

And Floppy Tape Memory is just for starters. Look at these other features. BASIC Language, 8080 CPU, 8 color CRT Terminal, 8K RAM Workspace, Selectable Baud Rate to 9600, Two RS 232 I/O's, Keyboard with 16 Function Keys, Background Color, Lower Case ASCII Characters, Roll, Insert/Delete, 48 Line X 80 Characters/Line, 2X Character Height, thorough operating instructions and a Graphics Mode with 160 X 192 Elements. And our unique Nine Sector Convergence System guarantees you quick set-up, exceptional stability and outstanding color registration in three to five minutes. If you can find a better buy in a color Intelligent CRT and Micro Computer system, let us



know. We think we've got the best of both worlds at the best price going. And we want to prove it to you.

Name your game.

After all, you'll have your very own personal computer right at your fingertips. For the most simple or complex tasks. Or just plain fun. The applications are unlimited. Color graphics and computations, check book balancing, educational instruction, tutoring and a unique variety of computer games. Like

Star Trek and Hangman and Pong. You can even sit back and enjoy a game of chess. Like we said, the applications are unlimited.

How about a little demonstration?

You'll find a list of our distributors at the bottom of the page. So drop by and ask for a demonstration. Get some answers to your questions. And if you aren't near one of our distributors, give us a call.

We've got the answers. The Compucolor 8001. You won't find a better buy in a color CRT Terminal and Micro Computer.

Compucolor Corporation

A subsidiary of Intelligent Systems Corp. ®

5965 Peachtree Corners East Norcross, Georgia 30071 Telephone (404) 449-5961

CALIFORNIA

Byte Shop 155 Blossom Hill Rd. San Jose, Ca. 95123 Larry Grihalva (408) 226-8383

Computer Store 1093 Mission St. San Francisco, Ca. 94103 Al Chern (415) 431-0640

CALIFORNIA

The Computer Center 8205 Ronson Rd. San Diego, Ca. 92111 Ron Eare (714) 292-5302

The Computer Mart of Los Angeles 625 W. Katella No. 10 Orange, Ca. 92667 George Tate (714) 633-1222

GEORGIA

The Computer Systems Center 3330 Piedmont Rd., NE Atlanta, Ga. 30305 Jim Dunion (404) 231-1691

ILLINOIS

Itty Bitty Machine 1316 Chicago Ave. Evanston, Ill. 60201 Jim Bannish (312) 328-6800

INDIANA

Home Computer Shop 10447 Chris Dr. Indianapolis, Ind. 46229 James B. Baughn (317) 894-3319

MASSACHUSETTS

The Computer Store 120 Cambridge St. Burlington, Mass. 01803 Sid Halligan (617) 272-8770

WASHINGTON

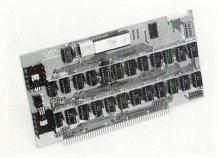
Retail Computer Store 410 N.E. 72nd Street Seattle, Wash. 98115 Tim Broom (206) 524-4101

Or Contact Us Direct

5965 Peachtree Corners East Norcross, Georgia 30071 Telephone (404) 449-5961

Z-80 CPU Kit For Under \$150

A Z-80 based CPU kit completely compatible for use in Altair or Imsai 8080 microcomputers. The board completely replaces existing 8080 based CPU's.



Special features include stops in M-1 state, on board sync generation, special buss bar power distribution scheme for superior low noise performance. All this in addition to the standard advantages gained when using the Z-80 MPU. This advanced circuitry is standard as with all products offered by S.D. The CPU board is in kit

form and includes all sockets, plated through P. C. board, and excellent quality components.

For further information contact S.D. Sales, P.O. Box 28810-E, Dallas, TX 75228; Phone (800) 527-3460.

CIRCLE INQUIRY NO. 228

System 68 Microcomputer

A 6800 based microcomputer system will be introduced at Electro '77 by Wintek. The system consists of a Wince Bus back plane with sockets for any 8 WINCE Micro Modules (Control, RAM, ROM, I/O, etc.), cassette interface for high speed load and dump with any audio cassette, power supply, front panel and cabinet.

Prices start at \$595, depending on configuration. A complete resident software package consisting of a monitor/diagnostic with single step capability, editor, assembler, basic, etc. is also available.

For further information contact Wintek Corp., 902 N. 9th St., Lafayette, IN 47904.

CIRCLE INQUIRY NO. 229

C-MOD Z80 CPU Board

A 4.5 x 6.5 CPU board is available from Mini Micro Mart using the industry standard dual 22 156 center edge connector. The board has gold fingers, is on epoxy-glass with plated-thru holes. It can be used to update a Microsystems International MOD 8 (8008) system, or MOD 80 (8080) system, or a C-MOD 80 system. It is ideal for an individual who wishes to construct a home brew Z80 system. All inputs, outputs and address lines are fully buffered. A crystal clock at 2 mhz is normally supplied, but other frequencies are available on special order.

In addition to the CPU and crystal oscillator, the board provides for adding a PROM or ROM with the necessary address decoding for the device. The foil pattern provides for the use of either a 2708/2704 E-PROM or an 8316B type ROM. "Kluge" area is provided on the board for user circuitry. Power up auto-restart is provided, as well as provisions for manual control. The kit comes complete with all TTL resistors, capacitors, and a Z80 CPU. The price is \$139.95. A Z80 manual is included.

For further information contact Mini Micro Mart, 1618 James St., Syracuse, NY 13203; (315) 422-4467.

CIRCLE INQUIRY NO. 230

Peripherals

Power-Fail/Auto-Restart/ Real-Time Clock

This multi-function board occupies a single ALTAIR™ compatible bus slot. It includes autopower on jump and power-fail interrupt.

Line-Frequency Real-Time Clock: The M705 includes a line-frequency real-time clock which may be used to generate interrupts 60 or 120 times per second. The clock interrupt can be enabled or disabled under software control and fully documented software routines are provided to keep a software clock, and to display time and date information on a video display if desired.

Delivery of the M705 will begin March 1. Price is \$89.95 kit, \$99.95 assembled and tested. Premium quality PC board, double-sided, plated-thru, gold-plated contacts. All ICs socketed.

For further information contact MicroLogic, P.O. Box 55484, Indianapolis, IN 46220.

CIRCLE INQUIRY NO. 231

OEM-Type Keyboard

The G.R.I. Model 753 keyboard is a new, guaranteed, OEM-type keyboard providing ASCII encoding for 53 keys in the familiar teletype format.



The KBM keyswitches and quality glass-epoxy printed circuit board assure mechanical ruggedness and ease of mounting. The key to the

753's versatility is the unique interface, which allows user selection of data and strobe sense, parity inversion, upper-case lock, and access to three user-definable keys for custom keycode or function assignment.

The Model 753 is available in either kit or assembled form, and comes with full documentation. Estimated construction time is two

Model 2-753-101-4 (assembled), \$59.95; Model 2-753-1-1-4K (kit), \$54.95. Delivery from stock.

For further information contact George Risk Industries Inc., GRI Plaza, Kimball, NE 69145, or phone (308) 235-4645.

CIRCLE INQUIRY NO. 232

HAL MCEM-KB/VDU

The HAL Keyboard/Visual Display Unit is designed for use with the MCEM-8080 Microcomputer by HAL. It allows keyboard input and video display without using the I/O ports of the microcomputer. The KB/VDU is a single circuit board the same size as the MCEM-8080 board. It attaches to the MCEM-8080 bus via a 40-pin connector.



The keyboard is arranged in a standard 52-key, upper case ASCII format. Video output is 1.0 V. p-p, with a 16 line by 64 character per line format. With minor modification, a TV set can be used as a monitor.

Useful subroutines in the KB/VDU PROM in-

clude a memory test routine, a Model 33 emulator routine, and others. The KB/VDU can be used as the console device for the MCEM-8080 or the entire system can be used as a Baudot or ASCII communications terminal. Price is \$300.00, assembled.

For further information contact HAL Communications Corp., Box 365, Urbana, IL 61801; (217) 367-7373.

CIRCLE INQUIRY NO. 233

New Acoustic Coupler from MI²

Design 76/4 acoustic couplers are designed to provide the maximum degree of data transmission reliability at data speeds up to and including 300 baud over even marginal quality telephone routes.



Four different models offer the customer a variety of features and functions to meet specific application requirements. As an example, Design 76/4 acoustic couplers are available as either originate only or originate and answer models. The Design 76/4 is also available with an option that allows the coupler to be used as a direct access data set when used in conjunction with a manual data access arrangement (CDT).

For further information contact MI² Corporation, 1212 Kinnear Road, Columbus, OH 43212; (614) 481-8131; Telex 245-359.

The Compucolor 8001 System.

It's A Stand Alone Micro Computer With Color Input/Output Capabilities All In One Package. For Only \$2995.

If you're looking for an input device, an output device and a micro computer all in one package, you've found it. The Compucolor 8001. It's here now, in color, on sale for only \$2995.

We gave it a memory of its own.

And Floppy Tape Memory is just for starters. Look at these other features. BASIC Language, 8080 CPU, 8 color CRT Terminal, 8K RAM Workspace, Selectable Baud Rate to 9600, Two RS 232 I/O's, Keyboard with 16 Function Keys, Background Color, Lower Case ASCII Characters, Roll, Insert/Delete, 48 Line X 80 Characters/Line, 2X Character Height, thorough operating instructions and a Graphics Mode with 160 X 192 Elements. And our unique Nine Sector Convergence System guarantees you quick set-up, exceptional stability and outstanding color registration in three to five minutes. If you can find a better buy in a color Intelligent CRT and Micro Computer system, let us



know. We think we've got the best of both worlds at the best price going. And we want to prove it to you.

Name your game.

After all, you'll have your very own personal computer right at your fingertips. For the most simple or complex tasks. Or just plain fun. The applications are unlimited. Color graphics and computations, check book balancing, educational instruction, tutoring and a unique variety of computer games. Like

Star Trek and Hangman and Pong. You can even sit back and enjoy a game of chess. Like we said, the applications are unlimited.

How about a little demonstration?

You'll find a list of our distributors at the bottom of the page. So drop by and ask for a demonstration. Get some answers to your questions. And if you aren't near one of our distributors, give us a call.

We've got the answers. The Compucolor 8001. You won't find a better buy in a color CRT Terminal and Micro Computer.

Compucolor Corporation

A subsidiary of Intelligent Systems Corp. ®

5965 Peachtree Corners East Norcross, Georgia 30071 Telephone (404) 449-5961

CALIFORNIA

Byte Shop 155 Blossom Hill Rd. San Jose, Ca. 95123 Larry Grihalva (408) 226-8383

Computer Store 1093 Mission St. San Francisco, Ca. 94103 Al Chern (415) 431-0640

CALIFORNIA

The Computer Center 8205 Ronson Rd. San Diego, Ca. 92111 Ron Eate (714) 292-5302

The Computer Mart of Los Angeles 625 W. Katella No. 10 Orange, Ca. 92667 George Tate (714) 633-1222

GEORGIA

The Computer Systems
Center
3330 Piedmont Rd., NE
Atlanta, Ga. 30305
Jim Dunion
(404) 231-1691

ILLINOIS

Itty Bitty Machine 1316 Chicago Ave. Evanston, Ill. 60201 Jim Bannish (312) 328-6800

INDIANA

Home Computer Shop 10447 Chris Dr. Indianapolis, Ind. 46229 James B. Baughn (317) 894-3319

MASSACHUSETTS

The Computer Store 120 Cambridge St. Burlington, Mass. 01803 Sid Halligan (617) 272-8770

WASHINGTON

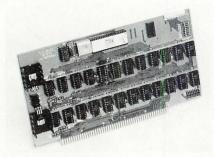
Retail Computer Store 410 N.E. 72nd Street Seattle, Wash. 98115 Tim Broom (206) 524-4101

Or Contact Us Direct

5965 Peachtree Corners East Norcross, Georgia 30071 Telephone (404) 449-5961

Z-80 CPU Kit For Under \$150

A Z-80 based CPU kit completely compatible for use in Altair or Imsai 8080 microcomputers. The board completely replaces existing 8080 based CPU's.



Special features include stops in M-1 state, on board sync generation, special buss bar power distribution scheme for superior low noise performance. All this in addition to the standard advantages gained when using the Z-80 MPU. This advanced circuitry is standard as with all products offered by S.D. The CPU board is in kit

form and includes all sockets, plated through P. C. board, and excellent quality components.

For further information contact S.D. Sales, P.O. Box 28810-E, Dallas, TX 75228; Phone (800) 527-3460.

CIRCLE INQUIRY NO. 228

System 68 Microcomputer

A 6800 based microcomputer system will be introduced at Electro '77 by Wintek. The system consists of a Wince Bus back plane with sockets for any 8 WINCE Micro Modules (Control, RAM, ROM, I/O, etc.), cassette interface for high speed load and dump with any audio cassette, power supply, front panel and cabinet.

Prices start at \$595, depending on configuration. A complete resident software package consisting of a monitor/diagnostic with single step capability, editor, assembler, basic, etc. is also available.

For further information contact Wintek Corp., 902 N. 9th St., Lafayette, IN 47904.

CIRCLE INQUIRY NO. 229

C-MOD Z80 CPU Board

A 4.5 x 6.5 CPU board is available from Mini Micro Mart using the industry standard dual 22 156 center edge connector. The board has gold fingers, is on epoxy-glass with plated-thru holes. It can be used to update a Microsystems International MOD 8 (8008) system, or MOD 80 (8080) system, or a C-MOD 80 system. It is ideal for an individual who wishes to construct a home brew Z80 system. All inputs, outputs and address lines are fully buffered. A crystal clock at 2 mhz is normally supplied, but other frequencies are available on special order.

In addition to the CPU and crystal oscillator, the board provides for adding a PROM or ROM with the necessary address decoding for the device. The foil pattern provides for the use of either a 2708/2704 E-PROM or an 8316B type ROM. "Kluge" area is provided on the board for user circuitry. Power up auto-restart is provided, as well as provisions for manual control. The kit comes complete with all TTL resistors, capacitors, and a Z80 CPU. The price is \$139.95. A Z80 manual is included.

For further information contact Mini Micro Mart, 1618 James St., Syracuse, NY 13203; (315) 422-4467.

CIRCLE INQUIRY NO. 230

Peripherals

Power-Fail/Auto-Restart/ Real-Time Clock

This multi-function board occupies a single ALTAIR[™] compatible bus slot. It includes autopower on jump and power-fail interrupt.

Line-Frequency Real-Time Clock: The M705 includes a line-frequency real-time clock which may be used to generate interrupts 60 or 120 times per second. The clock interrupt can be enabled or disabled under software control and fully documented software routines are provided to keep a software clock, and to display time and date information on a video display if desired.

Delivery of the M705 will begin March 1. Price is \$89.95 kit, \$99.95 assembled and tested. Premium quality PC board, double-sided, plated-thru, gold-plated contacts. All ICs socketed.

For further information contact MicroLogic, P.O. Box 55484, Indianapolis, IN 46220.

CIRCLE INQUIRY NO. 231

OEM-Type Keyboard

The G.R.I. Model 753 keyboard is a new, guaranteed, OEM-type keyboard providing ASCII encoding for 53 keys in the familiar teletype format.



The KBM keyswitches and quality glass-epoxy printed circuit board assure mechanical ruggedness and ease of mounting. The key to the

753's versatility is the unique interface, which allows user selection of data and strobe sense, parity inversion, upper-case lock, and access to three user-definable keys for custom keycode or function assignment.

The Model 753 is available in either kit or assembled form, and comes with full documentation. Estimated construction time is two hours.

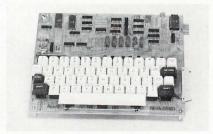
Model 2-753-101-4 (assembled), \$59.95; Model 2-753-1-1-4K (kit), \$54.95. Delivery from stock.

For further information contact George Risk Industries Inc., GRI Plaza, Kimball, NE 69145, or phone (308) 235-4645.

CIRCLE INQUIRY NO. 232

HAL MCEM-KB/VDU

The HAL Keyboard/Visual Display Unit is designed for use with the MCEM-8080 Microcomputer by HAL. It allows keyboard input and video display without using the I/O ports of the microcomputer. The KB/VDU is a single circuit board the same size as the MCEM-8080 board. It attaches to the MCEM-8080 bus via a 40-pin connector.



The keyboard is arranged in a standard 52-key, upper case ASCII format. Video output is 1.0 V. p-p, with a 16 line by 64 character per line format. With minor modification, a TV set can be used as a monitor.

Useful subroutines in the KB/VDU PROM in-

clude a memory test routine, a Model 33 emulator routine, and others. The KB/VDU can be used as the console device for the MCEM-8080 or the entire system can be used as a Baudot or ASCII communications terminal. Price is \$300.00, assembled.

For further information contact HAL Communications Corp., Box 365, Urbana, IL 61801; (217) 367-7373.

CIRCLE INQUIRY NO. 233

New Acoustic Coupler from MI²

Design 76/4 acoustic couplers are designed to provide the maximum degree of data transmission reliability at data speeds up to and including 300 baud over even marginal quality telephone routes.



Four different models offer the customer a variety of features and functions to meet specific application requirements. As an example, Design 76/4 acoustic couplers are available as either originate only or originate and answer models. The Design 76/4 is also available with an option that allows the coupler to be used as a direct access data set when used in conjunction with a manual data access arrangement (CDT).

For further information contact MI² Corporation, 1212 Kinnear Road, Columbus, OH 43212; (614) 481-8131; Telex 245-359.

Design 100 Data Sets by MI²

The Design 100 Data Set is a 0 to 300 baud, direct access, originate and automatic answer data set designed to interface input/output devices to both the TWX data network and to the DDD switched telephone dial-up network.



Remote Control Head for locating adjacent to EIA type input-output devices.

Remote Teletype Panel for mounting in the popular Model 33 Teletype®.

Design 100 electronics package for mounting within or on the side of the printer stand or desk.

For further information contact MI² Corporation, 1212 Kinnear Road, Columbus, OH 43212; (614) 481-8131.

CIRCLE INQUIRY NO. 235

Kimsi™ Kit

Our new kit (also available assembled) is an eight slot Imsai/Altair type mother board which attaches to MOS Technology's KIM-1 computer. Our Kimsi board contains all the interface circuitry as well as the eight slot S-100 bus connector area and attaches to any unmodified KIM thru its 44-pin expansion connector. Kimsi makes any Imsai/Altair type board plug-in compatible with KIM! KIM owners can now take advantage of the inexpensive S-100 bus memory

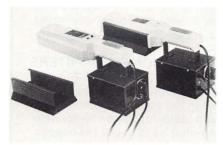
boards as well as video drivers, I/O cards, tape and disk controllers, etc., which are not available for KIM. Kimsi also has many built in features including power regulation for KIM and DMA facilities.

For further information contact Forethought, P.O. Box 386, Coburg, OR 97401.

CIRCLE INQUIRY NO. 236

Eprom Erasing

The need for greater programming flexibility in software has spurred the use of programmable read-only memories. These memories must be completely erased prior to reprogramming. Now, two new UV lamps manufactured by ULTRA-VIOLET PRODUCTS, INC., provide powerful short wave capability for fast, complete erasing in minutes. Erasing is both safe and automatic.



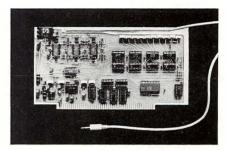
The new high-intensity S-52T, featuring timer assembly and holding tray, will erase up to 16 chips in about 7 minutes. The economical, but versatile, UVS-54T also includes a timer assembly and holding tray, and provides complete erasure for up to 8 chips in about 14 minutes.

For further information contact Ultra-Violet Products, Inc., 5100 Walnut Grove Ave., San Gabriel, CA 91778.

CIRCLE INQUIRY NO. 237

Speech Synthesizer

The Model 1000 Speech Synthesizer is a hardwired analog of the human vocal tract.



Various portions of the circuit simulate the vocal cords, the lungs, and the variable-frequency resonant cavity of the mouth, tongue, lips, and teeth. All of the information necessary to produce the speech sounds of American English has been programmed into ROM's which reside on the synthesizer board. The unit accepts a string of ASCII characters (each character representing a particular phonetic sound or phoneme) in exactly the same fashion as a printing peripheral. Because the synthesizer is primarily an analog circuit which is commanded digitally, new programming information is required only at the end of each completed phoneme. The maximum information transfer rate is very slow at about 50 bytes/sec. (25 bytes/sec typical). The Model 1000 is directly compatible with the Altair/IMSAI bus structure. A demonstration cassette is available for \$5.00. A programming manual which includes interfacing information costs \$4.00

Price: \$325.00. Delivery: stock to 4 weeks. For further information contact Ai Cybernetic Systems, P.O. Box 4691, University Park, NM 88003. Contact Wirt Atmar, (505) 526-6842.

CIRCLE INQUIRY NO. 238



PROM: Space for 2K bytes, 1702A. Store bootstrap loaders and monitors.

RAM: 1K bytes, 2102LIPC, 450 ns, low power. NO NEED TO RELOCATE STACK WHEN ADDING MEMORY.

CIRCUITRY: Replaces memory write logic on ALTAIRTM and Imsai front panels.

REGULATORS: Two regulators. No need for regulated power supply.

JUMP-ON-RESET: PROM program execution starts at any location in memory without interfering with programs in any other portion of memory.

S-100 BUS; +8 and -16 VDC; P/C BOARD SOLDER MASKED BOTH SIDES WITH PLATED THROUGH HOLES; ALL SOCKETS INCLUDED.

OPTIONAL FIRMWARE: 512 byte monitor for use with Tarbell tape interface on 2, 1702A PROMs.

 PROM/RAM KIT WITHOUT PROMS
 \$ 89

 + OPTION A - SIO Rev. 1 or 3 P + S
 \$129

 + OPTION B - 2 SIO (MITS)
 \$129

 + OPTION C - SIO 2 (IMSAI)
 \$129

 + OPTION D - Poly Video Interface (Includes Video Driver)
 \$159

California residents please add 6% tax.

IMMEDIATE DELIVERY FROM FACTORY OR YOUR LOCAL COMPUTER STORE

VECTOR GRAPHIC INC.

717 LAKEFIELD ROAD, SUITE F • WESTLAKE VILLAGE, CA 91361 • (805) 497-0733

NEW: from MATRIX PUBLISHERS

MICROCOMPUTER DICTIONARY AND GUIDE

Charles J. Sippl and David A. Kidd

Over 8000 definitions and explanations of terms and concepts relating to microprocessors, microcontrollers and microcomputers. Special sections on programmable calculators; math and statistics definitions; flow chart symbols and techniques; binary numbers and other related computer terms. There is also a comprehensive electronic/computer abbreviations and acronyms section. 704 pages.

PROGRAMMABLE CALCULATORS

Charles J. Sippl

An introductory textbook on calculators that reviews calculator capabilities, usage and programming from the basics of how to use keyboards, special function keys and preprogrammed units to advanced programmable calculator systems for use in engineering, science and communication. Includes a section on programming processes and procedures for calculators and a glossary of calculator terms.

1024 QUESTIONS AND ANSWERS ABOUT HOME COMPUTERS Richard L. Didday

A book for the person interested in microcomputers who wants to get an idea of what it can be like before buying the equipment and for the person with a microcomputer who wants ideas for things to do, help in reading the literature, help in deciding what ways to go. 144 pages.



CIRCLE INQUIRY NO. 46

MATRIX PUBLISHERS, INC.

Dept. IF, 207 Kenyon Rd. Champaign, IL 61820

Matrix books also available in Byte Shops, computer stores, and bookstores.

Tenney Introduces Microprocessor Programmer

At Electro 76, Tenney Engineering introduced a new programming module using microprocessor techniques. Offered as a standard option, exclusive in the industry, the new programmer interfaces with all Tenney environmental test chambers. It can be used in place of older cam, two-point, or punched tape programmers.

With programmable memory, the instrument is digitally addressed in English terms. The solid state device assumes command of temperature and humidity set-points, slope rate, dwell time, and secondary functions such as mode selection. Digital display of activated modes is one of its features.



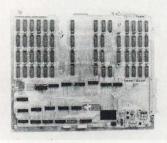
In the new microprocessor programmer, there are no cams to cut, tapes to punch, or timers to set. The operator digitally introduces set-points, times and rates of change, and time of program completion. Automatically, the instrument takes over. It will interface with the company's chambers which simulate temperature, humidity, alitude, or any combination. It is particularly useful in programming MIL specification tests, including those required by AGREE procedures.

For further information contact Frank Gardner, sales manager, Tenney Engineering, Inc., 1090F Springfield Road, Union, N.J. 07083.

CIRCLE INQUIRY NO. 239

HAL MCEM-7K RAM/PROM Programmer

The HAL MCEM-7K or MCEM-4K RAM boards provide extended memory for users of the MCEM-8080 Microcomputer. This unit is a single circuit board of the same size as the MCEM-8080. The board is available in four configurations: 4K with or without prom programmer, and 7K with or without prom programmer. Since the same physical board is used, a 4K board can be expanded to 7K at a later date.



The RAM used on the board is 2102A-4 static RAM. The Prom Programmer section is designed for user programming of the 2708 Erasable PROM. The controlling software on the board (contained in PROM) makes it a simple task to load the 2708 EPROM.

Prices are \$245.00 for the 4K RAM board and \$350.00 for 7K, assembled. Prom Programmer is \$35.00 additional, assembled.

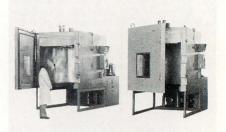
For further information contact HAL Communications Corp., Box 365, Urbana, IL 61801; (217) 367-7373.

CIRCLE INQUIRY NO. 240

DigiTenn Microprocessor Programmer

Tenney Engineering, Inc. has announced that its new DigiTenn microprocessor programmer is now the standard programming instrument on its extensive line of AGREE chambers. Replacing

the cam programmer and a timer, yet performing more functions than those instruments, DigiTenn is offered at no increase in price.



Tenney AGREE chambers simulate environmental conditions for the performance of tests recommended by The Advisory Group on Reliability of Electronic Equipment. In the workspace, extremes of hot and cold are programmed while the test specimen is automatically subjected to periods of active operation plus periods of simultaneous vibration on a shaker table. The microprocessor programmer schedules and coordinates all of the test parameters.

The microprocessor programmer is also interfaced with other Tenney environmental cabinets and rooms. Complete details on the DigiTenn, AGREE chambers, and other Tenney equipment are available from Frank Gardner, sales manager, Tenney Engineering, Inc., 1090S Springfield Road, Union, NJ 07083.

CIRCLE INQUIRY NO. 241

PROM Programmer and Verification Module

The MSI PROM Programmer is designed to program 1702A PROMs directly from microcomputer memory, and interfaces with any microcomputer system via a single PIA chip.



A complete software package is furnished with the system at no additional charge. This gives you the ability to transfer any area of memory to a PROM chip, read the contents of the PROM into memory, calculate check sums for PROMs, and duplicate PROMs. Following the programming operation, the software reads the PROM back into memory and compares each step with the memory location from which it was programmed for the purpose of verification. Any discrepancies are listed on the terminal with an error message. If the PROM verification is correct, then a checksum value is automatically printed.

PROM Programmer complete, including cabinet and power supplies, wired and tested, Model PR-1, \$325.00; UV Lamp for erasing PROMs, Model UV-1, \$95.00; PROM Programmer complete, including cabinet and power supplies, wired and tested, for programming 2708 PROMs, Model PR-2 (Available Spring 1977), \$325.00.

For further information contact Midwest Scientific Instruments, 220 W. Cedar, Alathe, KS 66061; (913) 764-3292.

Microprocessor Hardware Floating Point Board

North Star Computers, Inc. offers the FPB floating point unit, which performs decimal floating point add, subtract, multiply and divide with up to 14 digits of precision.

The Model-A FPB has the ALTAIR-IMSAI buss structure. The Model-B FBP is compatible with the Intel SBC and MDS buss structure. The FPB permits microprocessor systems to surpass minicomputers in processing power in applications where floating point operations are performed frequently. A typical 10 digit multiplication, when performed by the FPB, computes in 111 microseconds. The time is 5.5 milliseconds when the same operation is performed by the best 8080 firmware.



Furthermore, use of the FPB frees about 1K of program memory formerly allocated to firmware or software floating point alogorithms. Merely replace your arithmetic routines with subroutines which transmit the operands and the result (at about 6 microseconds per byte) to the floating point unit.

A version of extended BASIC will be available for use in conjunction with the FPB.

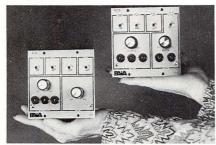
The FPB floating point unit is implemented on a single printed circuit board using Schottky and low power Schottky TTL integrated circuits. The FPB implements a high speed microprocessor which executes in excess of four million instructions per second. The microprocessor waits for a command from the 8080 program to start a floating point calculation. The command indicates the required precision. Then the microprocessor receives the two floating point values, computes the result, and returns the result to the 8080 along with a status byte indicating any error conditions.

For further information contact North Star Computers, Inc., 2465 Fourth Street, Berkeley, CA 94710; Telephone: (415) 549-0858.

CIRCLE INQUIRY NO. 243

Computer Music Synthesizer Modules

PAIA offers a complete line of low-cost voltage controlled music synthesizer module kits including the 4720 Oscillator and 4730 Filter shown. Both units feature linear freq./control voltage response and 16 Hz to 16 kHz range.



The 4720 VCO produces ramp, triangle, sine and pulse waveforms. The companion 4730 VCF is a state variable design with simultaneously available low-pass, band-pass and high pass outputs, all with "Q" adjustable from .5 to 150.

Other modules in the series include: Voltage Controlled Amplifiers, Balanced Modulators, Envelope Generators, Reverb Units, Noise Sources and Power Supplies.

All modules are compatible with the PAIA 8780 Equally Tempered DAC for easy computer/micro-processor/micro-controller interface.

Available in kit form from PAIA Electronics, Inc., 1020 W. Wilshire Blvd., Oklahoma City, OK 73116. Free catalog available upon request.

CIRCLE INQUIRY NO. 244

Programmer Option for Company's Model 950 ASCII Pattern Generator

The Model 954 Programmer expands the repertoire of characters to 128 in one message, 64 in each of two messages, four messages of 32 each, or any combination.



Message number is selected by dial on the front panel, the message then runs once or continuously as selected. One programmer may be shared by several Pattern Generators, since it plugs into them. The Model 954 uses field replaceable ROM, which can be replaced by the user at will.

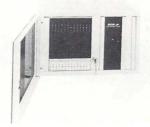
Uses for the Model 954 include simulation of sign on procedures, storage of commonly used subroutines in Microprocessor systems construction, storage of repetitive test messages. Data can be triggered at any external clock rate: data is presented in parallel. Using the company's Pattern Generators thru RS 232 interfaces, the data can be output from the Model 954 at speeds up to 57.6 KB per second.

For further information contact Terminal Data Corporation of Maryland, 11878 Coakley Circle, Rockville, MD 20852; (301) 881-7655.

CIRCLE INQUIRY NO. 245

Voice Response System

A new microcomputer-controlled Voice Response System which provides multi-line voice response output at exceptionally low cost for any minicomputer has been announced by MICOM Systems, Inc.



The MICOM 310 requires no complicated hardware or software interfacing while providing a simple interface to Touch-Tone® telephones, encoding the incoming Touch-Tone® signals to ASCII data characters for serial transmission to the host computer port. Thus, the 310 permits Touch-Tone® telephones to be used as complete data terminals in computer inquiry-response applications.

The MICOM 310 is simple to install and operate, with all the flexibility of microcomputer control.

Prices begin at \$500. Ninety days for delivery. For further information contact Roger Evans, MICOM SYSTEMS, INC., 9551 Irondale Ave., Chatsworth, CA 91311. Telephone (213) 882-6890. TWX 910/494-4910.

CIRCLE INQUIRY NO. 246

A-VID ELECTRONICS CO. has in stock:

SWTPCO at New Low Prices

 MP 6800 Microcomputer Kit now with 4K of memory Still only
 \$395.00

 4K Memory Expansion Kit (MPM + MPMX)
 Now only \$100.00

Coming in March: New 8K
Memory Kit
Order now \$250.00

From Smoke Signal Broadcasting:

• 16K Static low power Ram
Board assembled and tested
Available now \$595.00

Prom Board available Feb. 1st.
 Uses 2708's — Room for PIA's;
 comes with connector for
 Frugal Floppy \$179.00

Other Items:

Oliver Paper Tape Reader
 Kit \$74.50
 Assembled and tested \$95.00

 Lear Siegler ADM-3 24 line by 80 kit
 \$875.00

Prototype Boards - 3 kinds
 All under \$25.00 ea.

Software:

 SWTPCO Editor, 4K and 8K Basic from \$4.95
 Floating Point, Scientific Functions, TSC Games
 Vol. 3 All for \$53.00

Books:

New Basic Programs for business, math & etc. 3 volumes \$25 to \$40 Sippl's Dictionary \$9.43 Osborne's Microcomputers Vol. I & II \$7.50 & \$12.50



1655 E. 28th St., Long Beach, Ca. 90806

(213) 426-5526 -Ask for Reynold Johnson NEW HOURS:

Mon. - Wed. 8:00 a.m. to 5:00 p.m. Thurs. & Fri. 8:00 a.m. to 9:00 p.m. Saturday 9:00 a.m. to 5:00 p.m. BankAmericard & Master Charge Accepted

Paper Tape Equipment

Multi-Copy Printer Model 810

Designed and manufactured by Texas Instruments, the 810 is a 150-cps printer aimed at applications which include output printing for minicomputer and microprocessor systems, auxiliary forms printing for intelligent CRT terminals, and remote office output printers in data communications systems.

The printer electronics for the 810 incorporate the latest microprocessor design technology, providing microprocessor control of printing functions, programmable forms control, and a buffered communications interface.



The 810's microprocessor-controlled, bi-directional 132-column multi-copy printer offers significant improvements in total data throughput. While the data is held in the buffer, the microprocessor control selects the next line of data to be printed and directs the printhead either forward or reverse to achieve the shortest time to move to the next print position.

Speed of the Model 810 is 150 charactersper-second with an effective throughput from 60 full 132-character length lines-per-minute, up to 440 lines-per-minute maximum with an average of 10 character lines. The Model 810's wirematrix printhead makes possible up to six permanent copies with high clarity and a minimum of sound. The standard printer character set is 64 ASCII characters in a 9 x 7 dot pattern.

Other standard features include a 256 character communications line buffer, a self-test feature to test the printer, an adjustable tractor drive for form widths of from 3 to 14% inches, a line spacing selection of six or eight lines-perinch and the ability to feed continuous forms from the rear in true tabletop operation or from the bottom of the printer in conventional mode, and power selection of 100, 120, 220, or 240 VAC at 50-60 Hz.

For further information contact Texas Instruments Incorporated, Digital Systems Divisions, P.O. Box 1444, M/S 784, Houston, Texas 77001, or phone (713) 494-5115, extension 2124

CIRCLE INQUIRY NO. 247

Hobbyist's Printer

Expandor's printer is the economical answer to the computer-hobbyist's printing requirements. Complete with an 8-bit parallel interface, the unit operates at 10 characters per second, printing 80 characters wide with a 64 character ASCII code set. It has a pin feed platen which allows the use of continuous form or standard papers. Comparable to printers nationally offered at twice the price. Cost, \$266.00 complete.

For further information contact EXPANDOR INCORPORATED, 612 Beatty Road, Monroeville, PA 15146; (412) 373-0300.

CIRCLE INQUIRY NO. 248

Scribe[™] Matrix Printer Has Interactive Graphics Terminal Capabilities

Irvine, CA — Scribe[™], a medium speed matrix printer with very broad performance capabilities and exceptional reliability, has been introduced by Microdata Corporation.



The new printer comes in 120 or 165 character per second versions printing 132 column lines bidirectionally using a 9 x 7 dot matrix. It prints the full 96 character USASC II set and can highlight data with a selectable, expanded type face. An optional second character set is specifically designed for plotting and graphics printing.

Scribe is available with either an RS232 C serial interface or an industry standard parallel interface, making it plug and software compatible with most other printers and terminals.

In quantities of 100, the 120 cps Scribe unit is priced at \$1,755; keyboard price is \$275. Immediate deliveries are available.

For further information contact Microdata Corporation, 17481 Red Hill Avenue, Irvine, CA 92714; (714) 540-6730.

CIRCLE INQUIRY NO. 249

Full-size Impact Printer

The Digital Group printer is the first affordable printer available for computer hobbyists and the small businessman.



Although the Digital Group printer is inexpensive to own, it comes loaded with capabilities and features.

The Digital Group printer is fast, printing 120 characters per second.

There are 96 characters per line, 12 characters per inch horizontal and 6 lines per inch.

The Digital Group printer makes up to four copies simultaneously.

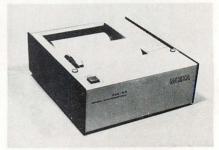
Kit prices start at \$495 for the printer and interface card.

For further information contact The Digital Group, P.O. Box 6528, Deriver, CO 80206, Telephone (303) 777-7133.

CIRCLE INQUIRY NO. 250

Axiom EX-800 Electrosensitive Line Printer

The new EX-800 printer uses a fast and efficient electrosensitive printing technique to achieve relatively high performance at a moderate cost. It is priced at \$655.00 including parallel ASCII interface and offers the following features as standard:



96 character ASCII printout (upper and lower case); Built-in self-tester for rapid system diagnosis; Three character sizes selectable to give 80, 40, or 20 columns per line; 2 lines per second for throughput of up to 160 characters per second; Printed character size may be preset or programmed character-by-character; Low cost paper gives hardcopy for around one cent for an 8½" x 11" equivalent; RS232C interface available (\$85.00 extra).

For further information contact Axiom Corporation, 5932 San Fernando Road, Glendale, CA 91202; (213) 245-9244.

CIRCLE INQUIRY NO. 384

Hard Copy For Computer Art

The X-Y plotter can be driven directly from a TTL compatible 8-bit parallel I/O port. The mechanics are assembled and aligned with the three controller P.C. boards assembled and tested.

The user need only to interconnect the mechanics, P.C. boards, and his computer. Step-by-step connection and programming suggestions are contained in the owner's manual



The encoder gives .01 or .005 inch resolution (specify) for controlling pen travel and RPM of the motors. The universal pen holder accepts almost anything. Pen speed is 2.5 ipm minimum. Model DFT-1: drawing area 11 X 17 costs \$750, stock; Model DFT-2: 17 X 22 costs \$895 and is delivered in 3 to 8 weeks. Owner's manual is \$5. Requires 24VDC @ 1.5 amps and 5 VDC @ 200 mA

For further information contact Sylvanhills Lab., Inc., #1 Sylvanway, Box 239, Strafford, MO 65757; (417) 736-2664.

Digital Recorders

Cartridge Tape System Incorporates Full ANSI Format

The first cartridge system that completely implements American National Standards Institute (ANSI) recording format has been developed by Kennedy Co. Designated the Series 4000, the system accepts byte-oriented data, and phase encodes it at 1600 bpi complete with preamble, postamble, and cyclic redundancy check. The easily interfaced system also provides timing and control for up to four one-quarter-inch tape drives.



Designed for minicomputer and other data processing applications using eight-bit bytes, the Series 4000 organizes the data to bit serial on the tape. No additional parallel-to-serial converter is needed. Because bytes are not separated by start/stop bits, all available space is used for data.

The low profile system mounts in standard 19 inch racks. The one-recorder model, 4000-1, is 5.25 inches high; the two-recorder model, 4000-2, is 8.75 inches high; the three-recorder model, 4000-3, requires 10.5 inches; and the four-recorder model, 4000-4, is 14 inches high.

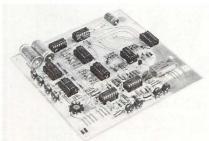
Single-unit prices, including power supply, cables, and connectors are: Model 4000-1 — \$2495; Model 4000-2 — \$3600; Model 4000-3 — \$4950; and Model 4000-4 — \$6050. Delivery is 45 days ARO.

For further information contact Kennedy Co., 540 West Woodbury Road, Altadena, CA, 91001; (213) 798-0953, TWX 910-588-3751.

CIRCLE INQUIRY NO. 252

Digital Read/Write Amplifiers

Phi-Deck has introduced digital read/write amplifiers for its family of remote controlled cassette transports.



The one or two-channel amplifiers permit the user to utilize almost any encoding methods commonly used. Phi-Deck presently is designing coding boards for micro processing systems applications.

The unit uses a Philips certified data cassette, has a recording density of 0-1600 FRPI (flux reversals per inch). It is %inch by 6 % inches by

6% inches and weighs 6 ounces. Power requirements are ± 15 volts, ± 15 volts.

For further information contact Triple I, a division of The Economy Company, P.O. Box 25308, Oklahoma City, OK 73125; (405) 521-9000.

CIRCLE INQUIRY NO. 253

MFE's Model 5000 Uses Microprocessor

MFE's Model 5000 Buffered Tape Cassette Terminal is the only system using a micro-computer for control and efficiency in the communications terminal market.



Controlling the terminal's buffering, editing, and communication is MFE's integration of the Intel 8080A Microprocessor. Programmed high speed search and powerful edit functions, as well as full communications capability, are all standard features of this highly reliable system.

The MFE Model 5000 uses Read/After/Write and CRC for error detections and has extensive data correction routines. It conforms to AN-SI/ECMA standards (Industry Defined), with tape speeds up to 120 inches per second on cassettes which hold 221,000 characters of formatted data.

For further information contact MFE, Keewaydin Drive, Salem, NH 03079; (603) 893-1921, TWX 710-366-1887, Telex 94-7477.

CIRCLE INQUIRY NO. 254

3M3 Digital Data Recorder

"COMPUTER AID" Model 3M3 Digital Data Recorder utilizes a radically new drive system for the 3M Data Cartridge (DC 300). This drive and the unique "UNIBOARD" method of construction make it possible to produce a data cartridge recorder for about one-fourth the normal price of such recorders. Operates in the self-clocking Phase Encoded mode at 9600 baud or less. Motor and record/play functions are under keyboard or software control. Overriding pushbuttons make manual operation possible. Readily interfaces with commonly used microprocessors and minis with serial I/O ports.

Available also in export version. Price includes read/write electronics Phase Encoder board (16 X or 1 X clock) and motor control electronics. Delivery 4 weeks ARO.

For further information contact National Multiplex Corporation, 3474 Rand Ave., Box 288, South Plainfield, NJ 07080. Price \$220.00.

CIRCLE INQUIRY NO. 255

HAL MCEM-DACI

The HAL Dual Audio Cassette Interface allows mass storage of programs using a standard audio cassette recorder. The DACI uses the "Kansas City Standard" of recording data on audio tape. Rates are 300 and 600 baud, switch selectable, or 1200 baud by changing an internal strap. Two cassette recorders can be interfaced to your

microcomputer through the DACI. The provision for "pass through" operation allows the passing of data to or from other serial I/O devices attached to the microcomputer. Front panel indicators and push-button switches allow full operator control and monitoring of the cassette memory system.

The DACI can be used to load HAL Tiny BASIC into your MCEM-8080 system via audio cassette tape. HAL Tiny BASIC resides in 3K of memory and uses the MCEM-8080 software monitor routine. Once you have Tiny BASIC loaded, use the DACI to record or play back programs that you have written.

Price of the DACI is \$150.00, assembled. Tiny BASIC on audio cassette tape is \$15.00.

For further information contact HAL Communications Corp., Box 365, Urbana, IL 61801; (217) 367-7373.

CIRCLE INQUIRY NO. 256

10-Megabyte Cartridge Tape Drive

Irvine, CA — Lodestar the first magnetic tape cartridge drive to offer 10-megabyte storage capacity on a 3M-type data cartridge, is now available from Microdata Corporation.



Lodestar is available in several versions for OEM applications, including single and dual-drive units. Options include power supply, a formatter, rack mounting hardware, and front panel with controls and indicators. The rack mountable unit will house the optional formatter. The basic single-drive unit is priced at \$1401 in quantities of 100. Immediate delivery is available.

For further information contact Microdata Corporation, 17481 Red Hill Ave., Irvine, CA 92714.

CIRCLE INQUIRY NO. 257

New AC Phi-Deck Model 4 Tape Transport Available

The Triple I Division of The Economy Company of Oklahoma City is offering a new fixed speed electronic cassette tape transport with AC capstan motor to its line. Prototype quantities are now available. Features of this model include: four-motor control, remote control capabilities, fast start/stop, less than 30 seconds rewind, and speeds from 1 to 15 IPS.

In addition to use in micro processors, the unit has applications in data recording/logging/storage, programming, instrumentation, industrial controls, data duplicating, security/automatic warning systems, testing apparatus, audio-visual education, hi-fi, and other general applications

For further information contact Triple I, a division of The Economy Company, 4605 North Stiles, P.O. Box 25308, Oklahoma City, OK 73125; Phone (405) 521-9000.

Discs

"Reflex" Disc Drive Aimed At Storage Module, Trident And IBM 2314

Irvine, CA — Microdata Corporation offers a "Winchester technology" disc drive. Named Reflex, the drive is available in three basic versions having one, two or three disc platters and providing 12.5, 37.6 or 62.7 million bytes of storage in a compact 7-inch-high rack mountable package.



Significant performance characteristics of the drive include head positioning time of 6 milliseconds track to track, 30 milliseconds average. Disc rotation at 3000 rpm results in an average rotational latency of just 10 milliseconds and a data transfer rate of 7.08 MHz.

Unlike the IBM 3340, Reflex's media module is not removable. By eliminating the remova-

bility feature, Microdata can offer the advantages of Winchester technology at a price that is very attractive to minicomputer system builders and users.

Delivery is 30 to 45 days ARO. The 100 quantity price for a 62.7 megabyte is \$3600.

For further information contact Microdata Corp., 17481 Red Hill Ave., Irvine, CA 92714; (714) 540-6730.

CIRCLE INQUIRY NO. 259

Full-size Floppy Disk for the Altair-Imsai Plug-in Compatible S-100 Bus

The Peripheral Vision floppy disk interface card supports 8 drives and stores over 300,000 bytes per floppy.



A bootstrap EPROM is included to make system startup automatic. The floppy is completely S-100 plug-in compatible, and interface cabling is included.

The Peripheral Vision floppy disk drive is from Innovex (the originator of the floppy concept) and comes assembled and tested. A disk operating system with file management system is included on the floppy.

Prices start as low as \$750 for the interface card kit and assembled and tested drive. A 24-volt at 2-amp power supply is also available in kit form for \$45 or assembled for \$65; and a cabinet is offered for an additional \$85.

For further information contact PERIPHERAL VISION, P.O. Box 6267, Denver, CO 80206; (303) 777-4292.

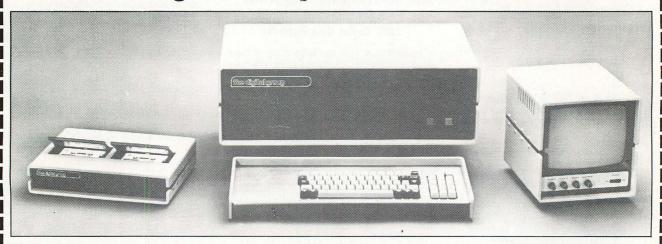
CIRCLE INQUIRY NO. 260

North Star Micro-Disk System

The North Star™ Micro-Disk System is a complete floppy disk system for 8080 and Z80 computer systems which follow the S-100 (ALTAIR/IMSAI, etc.) buss conventions. For a complete, disk-oriented computer system, all that is needed is the computer, 16K bytes of memory, a terminal and the North Star Micro-Disk System.

At the heart of the North Star Micro-Disk System is the Shugart SA-400 minifloppy disk drive.

Sunshine Computer Company is pleased to announce that we are now a representative of The Digital Group in Southern California.



Software is available! including Basic, Assembler, Disassembler, Text/Editor, Z-80 Educator!

Z-80-SYS 1: Complete 4-Board Z-80 system including: 10K memory, 12A power supply, Standard Motherboard, Standard Cabinet,(kit). 895.00

Sunshine Computer Company

COME SEE OUR NEW EXPANDED OFFICES IN THE CARSON BUSINESS PARK.

20710 South Leapwood Avenue Carson, California 90749 Rich Travis (213) 327-2118

The North Star Micro-Disk Controller interfaces the disk drive to the computer system. Commands and data are transferred from software by the technique of memory-mapped I/O. No input or output ports of the computer are used.

The North Star Disk Operating System (DOS) is supplied on diskette. The DOS provides access to the disk either through commands typed from the computer terminal, or through subroutines called by software.

The Extended Disk BASIC, an integral part of the Micro-Disk System, is supplied on diskette. The extended features include: Strings (no limit on string length), Multiple dimensioned arrays, Multiple-lined user defined functions with multiple arguments, Formatted output facility, Machine language CALL and memory EXAM and FILL, IF - THEN - ELSE and ON - GOTO statements, RENUMBER command, Convenient line

For further information contact North Star Computers, Inc., 2465 Fourth Street, Berkeley, CA 94710; Telephone (415) 549-0858.

CIRCLE INQUIRY NO. 261

New High Performance Dual Disk System

The Jupiter D system pairs a dual floppy disk drive from PerSci and a high quality soft sectored disk interface, Built on standard Wave Mate wire wrap hardware, the controller can handle up to four devices at once.

This dual drive accesses data several times faster than other drives and, like all Jupiter components, uses five times less power than most other systems. Each removable disk will hold 315,392 bytes of information in a soft sectored

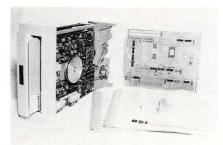
The unit is housed in a standard Jupiter rack mount cage which can be mounted underneath or sit alongside a Jupiter computer. The system includes its own ferro-resonant plug-in power supply, the dual drive, cage, interface card and cables fully assembled and tested for \$2195.

For further information contact Wave Mate 1015 W. 190th Street, Gardena, CA 90248; (213) 329-8941

CIRCLE INQUIRY NO. 262

OSI 470B Floppy Disk

The 470B is an upgrade of OSI's popular 470 floppy disk. The new disk features a GSI model 110 disk drive for 240K bytes single density storage or 480K bytes double density storage.



The new disk also features a head load indicator and a pre-fabricated fifty line interconnecting cable. The introductory special for the 470B is \$599 for a fully assembled drive and cable harness, 6502 disk operating system, and controller board in kit form.

The drive is also available fully assembled for OSI Challengers including matching case and power supplies for \$990. OSI's floppy disk bootstrap prom allows the owner of any OSI system to use his floppy disk immediately on power up and is available for \$29 with either version of the 470B.

For further information contact Ohio Scientific Instruments, 11679 Hayden St., Hiram, OH 44234; (216) 569-7945.

CIRCLE INQUIRY NO. 263

Software Supported Floppy Disc Controller

The μ PAL FDC 1016 Floppy Disc Controller for S-100 BUSS compatible microcomputers can handle up to eight discs to achieve a large data storage base. A sophisticated software package, tapes and listings, is available for \$25. The controller, in kit form, sells for \$395. A controller kit and a single disc drive are available for \$995

The single card controller contains a DMA interface. Formatting capabilities are provided. IBM 3740 and other formats are possible, as well as error detection features. Operating under the DFM 80 portion of the software package, the user need only be concerned with the name of the file, the operation to be performed and the physical disc upon which the file resides.

In addition, the software package contains a monitor, debugger and bootstrap programs. A system program formats discs and establishes linkages to the operating system.

For further information contact Processor Applications, Ltd., 2801 East Valley View Ave., West Covina, CA 91792 or phone (213) 965-8865

CIRCLE INQUIRY NO. 264

Microfloppy™Unit Boosts Personal Computing With First Plug Compatible 5 1/4" Diskette System

CANOGA PARK, CALIF., January 5, 1977 -A floppy disk system called the Microfloppy™ with operating software and interface electronics to provide complete plug compatibility with popular microcomputers has been announced.



The system is believed to be the first available for the new 51/4-inch diskettes. Priced at just \$1,095, the Microfloppy, iCOM® Model FD 2411, includes the flexible disk drive, power supply, cabinet, controller/interface card, power cord, fuse and all cables. The unit, incorporating iCOM's FDOS-M software on diskette, is fully factory assembled and tested, and is ready to plug in. Additionally, as a limited-time introductory offer, an 8K BASIC software package is included at no additional charge.

The iCOM FD 2411 is 100% plug compatible with the Altair 8800, the Poly 88, the IMSAI 8080 and other microcomputers using the popular Altair bus format. The controller/interface card, which uses advance MOS LSI and low power Schottky technology, contains all of the electronics necessary to interface the floppy disk to the microcomputer.

The controller/interface card features onboard ROM and RAM to make system memory more efficient and minimize user memory requirements. The Microfloppy also uses phaselocked-loop techniques for improved accuracy and performance, usually found only in more expensive disk systems.

The Microfloppy Model FD 2411 is priced at \$1,095 for the fully assembled unit, ready to plug in.

For further information contact iCOM Division, 6741 Variel Avenue, Canoga Park, California, 91303. Telephone: (213) 348-1391.

CIRCLE INQUIRY NO. 265

NOW TRY US!

The word is getting around . . . the Byte Shop of Pasadena is a remarkable exception to the rule among computer stores. We offer a truly delightful environment supported by

- * REAL courtesy
- * REAL expertise
- * EXPERT service
- * GREAT classes

* EIGHT demo systems and of course, a wide variety of lowpriced computer hardware, software, tools and supplies. Come see what the

happy rumors are all about . . . then

compare our store with ANY other!



The BYTE SHOP of Pasadena 496 South Lake Avenue Pasadena, California 91101 Telephone: (213) 684-3311

- HOURS -

Tuesday-Saturday: 12-9 Sunday: 12-5

Monday: closed





Bankamericard American Express

Mastercharge

Terminals

New MI² Terminal

Designated the Design 2400 KSR/T, the terminal combines the elegance of simple, clean, quiet mechanical design with the intelligence of microprocessor control. The extensive flexibility for communications capability with a variety of data systems is further enhanced by the availability of a Programmable Protocol Interface Board. The new system thus becomes easily

adaptable to time sharing systems and can communicate with various protocol modes.

The Programmable Protocol Interface Board incorporates the powerful Intel 8080 Micro CPU which is factory or user programmable to meet multi-terminal demands. This universal interface is also available for the R/O version of the printer.

For further information contact MI² Corporation, 1212 Kinnear Road, Columbus OH 43212; (614) 481-8131.

CIRCLE INQUIRY NO. 266

High impact plastic cabinet with Rosewood finsh

CALL COLLECT FOR NICK

MASTERCHARGE WELCOME

'When you're #32

You try a lot

harder!"

TO ORDER

1-803-771-7824

BANKAMERICARD &

All for \$399.00

Abacus Computer System Terminal

Abacus Computer Systems has a low cost, portable computer terminal that is suitable for microcomputers, computer evaluation kits, data entry systems and time sharing systems. This terminal weighs under 25 pounds with the integral keyboard, hardcopy printer and acoustical coupler.



The terminal is TTY compatible or it can be connected directly to the computer serial I/O port which has standard TTL voltages level. The acoustical coupler can be used to transmit and receive data over the phone lines. The coupler can also be used to load and store data on audio cassette tapes at speeds up to 300 bauds. The keyboard is ASCII encoded and consists of 51 alphanumeric solid state keys. The printer uses half inch strip, impact sensitive paper. The printer speed is 110 bauds.

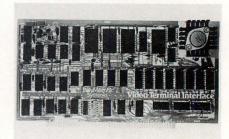
The model 800 is \$295.00. The cost without the acoustical coupler is \$225.00.

For further information contact Abacus Computer Systems, 6315 Eunice Avenue, Los Angeles, CA 90042; (213) 666-1711.

CIRCLE INQUIRY NO. 267

Video Terminal Interface

The versatility of the video terminal increases the abilities of your S100 compatible computer.



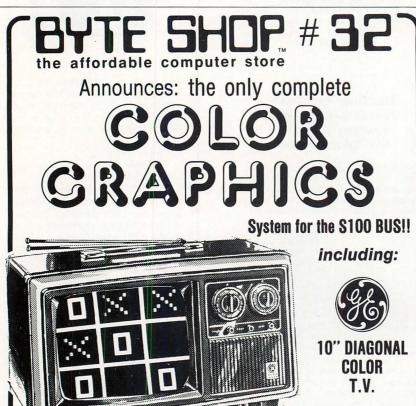
The user supplies information through the keyboard input port for processing by the computer, and the computer displays the resulting data on the monitor screen in character or graphic form.

7x9 matrix alphanumeric characters, 128 horizontal by 48 vertical graphic resolution, 64 characters per line with 16 lines.

The video interface provides a window into the computer, and allows the user to display rapidly changing information in the form of upper and lower case characters, special symbols, and graphics. Kit \$210; Assembler \$280.

For further information contact PolyMorphic Systems, 460 Ward Drive, Santa Barbara, CA 93111

CIRCLE INQUIRY NO. 268



and: the famous TV DAZZLER MKIT by Cromemco

CIRCLE INQUIRY NO. 50

S.C. residents must add 4% sales tax

the affordable computer store

2018 Green Street

Columbia, SC 29205

Computer Terminal Costs Only \$400 Complete With ASCII Keyboard, Display and RS-232

THe KDM/1 terminal with built-in display allowing two-way computer data communication between a person and any RS-232 interface device has been announced by Micon Industries at a mail-order price of only \$400 per unit.



The KDM/1 terminal with built-in display devices to provide reliable performance with digital computer systems, computer-controlled test equipment, and several special purpose devices such as bar code readers, OCR scanners, and microprocessor development systems. It combines in a single compact unit a full ASCII keyboard, 32 character alphanumeric LED display, AC power supply and RS-232 interface.

All the KDM terminals use ASCII Code and operate at any of eight switch-selectable baud rates — up to 9600. The 16 x 64 character disply terminal is designated KDM/2 and operates on a TV set; while the KDM/3 provides a 24 x 80 character display on a video monitor.

Delivery is stock to 30 days, dependent upon color choice and optional features.

For further information contact Micon Industries, 252 Oak Street, Oakland, CA 94607; (415) 763-6033.

CIRCLE INQUIRY NO. 269



MICROCOMPUTERS PERIPHERALS ACCESSORIES

IMSAI 8080 BYTE-8 SWTP MP68 CROMEMCO PROCESSOR

MEMORY EXPANSION COLOR TV GRAPHICS LEAR SIEGLER ADM 3 PAPER TAPE READER

PROCESSOR TECH INTERFACES (KITS or ASSEMBLED UNITS)

AFFORDABLA

COMPUTER STOR



PROGRAMS AND SOFTWARE

VARIOUS BASICS — TINY, 4K, 8K and 12K. FOCAL — DOS — GAMES — BUSINESS APPLICATIONS.

ALSO AVAILABLE ... APPLE 1 CASSETTES FLOPPIES MODEMS TERMINALS DEC. WRITERS

BUSINESS APPLICATION INQUIRES INVITED SYSTEM DEMONSTRATIONS AND LITERATURE / MAGAZINES.

BYTE SHOP EAST, INC. 27-21 HEMPSTEAD TURNPIKE LEVITTOWN, LONG ISLAND (516) 731-8116

TWO BLOCKS EAST OF WANTAGH PKWY.

HOURS: TUES. thru FRIDAY 11 to 9 SATURDAY 10 to 5

CIRCLE INQUIRY NO. 51

I/O Card

Microprocessor/Interface Board Offers Multi-Level Bussing

A new Plugboard accommodates up to two supply voltage levels. Designated Model 4350, the board has copper cladding on opposite sides for shielding and to supply primary power (plus on one side, negative on the other). Interwoven zig-zag lines, also on opposite sides, facilitate power distribution. The combination allows convenient use of both MOS and TTL devices.

The large 7 in. by 9.6 in. board will hold 63 fourteen- or sixteen-pin DIPs. Alternately, five 24-pin microprocessors and 45 DIPs may be placed in the main field. Either socket blocks or individual socket pins may be mounted to order, or the board will mount 40-pin microprocessor (0.6 in. tab spacing) units.

The boards are priced at \$14.95 each in 1-19 quantity with quantity discounts available.

For further information contact Vector Electronic Co., Inc., 12460 Gladstone Ave., Sylmar, CA 91342; (213) 365-9661; TWX 910-496-1539.

CIRCLE INQUIRY NO. 270

Exorciser/Micromodule-Compatible Analog I/O System

Motorola Microsystems has expanded the Micromodule Family of OEM-oriented products by adding a modular data acquisition system to the line. The system consists of an 8-channel, differential-input module called Micromodule 5A (MM5A), a 16-channel, single-ended-input module (MM5B) and a 4-channel analog output module (MM5C).

The analog input voltage range of the MM5A&B is ± 10 mV to ± 10 V; the input current range is 4 to 20 mA or 10 to 50 mA (resistor programmable). Input impedance is 100 meg Ohms; amplifier gain range is 1 to 1000 V/V (resistor programmable).

The MM5A&B both contain an input multiplexer, a high gain instrumentation amplifier, sample/hold circuit, 12 bit A/D converter, timing/control/address decode logic and a +5 V to ±15 V dc-dc converter. Throughput accuracy is ±0.025% Full Scale Range (±10 V input). Sample/hold aperture time is 30 nanoseconds; common mode rejection ration (for differential inputs is 74 dB (DC to 2 KHz).

For further information contact Motorola Microsystems, (602) 244-6815 or the Techni-

cal Information Center, Motorola Semiconductor Products, Inc., P.O. Box 20294, Phoenix, AZ 85036.

CIRCLE INQUIRY NO. 271

RO-CHE Assembler I/O

RO-CHE SYSTEMS announces a new 8080 CPU Assembler for use with their Multi-Cassette Controller. This new assembler (Assem 1.0) now makes it possible to assemble source code programs larger than memory.

The Multi-Cassette Controller allows an 8080 computer to read or write individual records to any of four software selected recorders, rather than blocks of data. Normally with a two-pass assembler the source code resides in memory. The RO-CHE Assem 1.0 reads the source code from cassette tape record by record and builds a symbol table during the first pass. During the second pass the source is read again and the object code is created and stored in memory. Upon completion of the second pass the assembled program may be executed or dumped to cassette

Assem 1.0 is available from RO-CHE Systems, 7101 Mammoth Ave., Van Nuys, CA 91405, for only \$10.00. Included is the Assem 1.0 and line editor on cassette tape with an instruction manual.

Joint Venture Group OEM Buys DISCOUNT DISTRIBUTION

eacar, ouc.

Mon., Wed., or Fri.

7338 BALTIMORE AVENUE; SUITE 200 COLLEGE PARK, MARYLAND 20740

SPECIAL!

TV TERMINAL KIT_ COMPUTER TIME-SHARING

plus shipping and handling--consists of a Pennywhistle modem, an ADM-3A kit, plus addressable cursor option, plus upper-lower case option, plus 24 lines by 80 columns, plus cable.

SPECIAL! INIONI OUOU **IMSAI** 8080 \$594.15 IMSAI 8080 box with TDL's Z-80\$794.60 E E E IMSAI 8080 box with TDL's Z-80 \$839.80 EXP-22 ...erc 10% OFF LIST 10% OFF LIST 10% OFF LIST microP, 32 bit I/O, sockets, hardwar vivname; etc ets

		Carried State of Stat
	15% OFF LIST 10% OFF LIST	SEALS 8K Battery Backup Mem- CROMEMCO Dazzler, Bytesaver
NORTH STAR disk drive and controller		SANYO TV Moniters
TDL, ZPU, Z16K, etc	10% OFF LIST	TEC-9900-SS-UF TI9900 16 bit
PERSCI Dual floppy & intelligent controller (270)	£ 1070)\$1395.00*	mult & div , buffered bus, 8 price
SHUGART MINI-FLOPPY	\$375.00*	TEC-9900-MA-32KB 32K bytes D
MSI Floppy disk system	10% OFF LIST	Nat. Multiplex digital tape record
ADM-3K + addressable cursor \$925.00 list	10% OFF LIST	AXIOM 80 column, 160 char sec
TI "silent 700" model 743,\$1395 00 list		parallel list 665 00
Pennywhistle modern	5% OFF LIST	serial list 740 00
ASTRAL 2000 kits	10% OFF LIST	plotter list 795 00

	All AMD	chips are PRIME FACTORY TES	TED for MIL-ST	D-883C	
91L02 500ns 9102 500ns	\$1.90°	91L02 400ns5 9102 400ns5	\$1.99	add .25 for so	
2102 650ns	\$1.75	2102 350ns ⁵	_\$2.50*	add .25 for so add .25 for so	
Z-80 8080A 2.5 MH	\$54.00 \$17.00	Z-80PIO 8228 system controller	\$15.00 \$5.50*	Z-80CTC 8216/26 Bus driver	
8080A3.0MH 8212 I/O port		8224 clock generator 8255/9555 PPI Interface	\$4.75	25LS138 1 of 8 decoder	\$1.1
2708 1024X8 EPROM	\$65.00	8080SCI	\$9.50° \$10.00°	8251/9551 PC Interface 2900 4 bit slice	\$25.00
1702A 2048 bit EPROM	\$8.00	9130/40 500ns	\$10.00*	9130/40 200ns	\$20.00

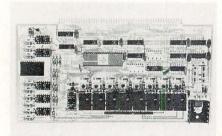
Send \$2.00 for Newsletter-Tipsheet and flyers

Minimum order \$100-| For shipping and handling charges add 4% for first \$500 of order, 3% of next \$1000, 2% for next \$1000, 1% for next \$25001 Full prepayments for discounts| orders bulked for lowest discount on OEM Group buys| prices and products subject to change without notice! Except for OEM buys, delivery usually 3-6 weeks after acceptance of order.| Allow 15 working days for personal checks to clear or send bank or certified check:| Purchase orders and collect orders refused for discount prices. **OEM Joint venture group buy

CIRCLE INQUIRY NO. 52

PCI Boards Offer Unlimited Potential

Both the Altair 88-Process Control Interface board and the new, similarly designed 680b-Process Control Interface board enable Altair computers to communicate with the real world of relays, switches, motors, fans, contacters, alarms, solenoids, lights, heaters and many other electromechanical devices. The 680b-PCI and the 88-PCI boards can be used in almost any instance where the computer must control large amounts of power.



Each board has eight relay outputs with SPST operation that are capable of switching 1 amp at 120 VAC. But with external relays added, the amount of power that can be controlled is essentially unlimited. Both boards also have opticallyisolated inputs, which can be configured to accept a wide range of input signals.

Two pairs of optically-isolated, softwarecontrolled "handshake" lines are also provided for interfacing with external devices. All lines are isolated and balanced for operation in electrically noisy environments.

For further information contact MITS, 2450 Alamo S.E., Albuquerque, NM 87106.

CIRCLE INQUIRY NO. 273

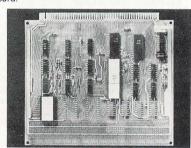
Prototyping Board Simplifies Microprocessor Design and Checkout

ders c. 5" paper

_10% OFF LIST _10% OFF LIST _10% OFF LIST

A new hardware development tool for microprocessor-based systems that allows a user to configure an accurate prototype with a minimum of design effort is now available from Signetics.

Called the Adaptable Board Computer (ABC), the prototyping tool matches the accuracy of a development system built from scratch with the convenience of a pre-assembled prototyping card



Signetics' ABC comes complete with a 2650 microprocessor, ROM and RAM, input/output ports and a system clock. The unit can be adapted to multiple configurations by a system of jumper wires and additional plated-through holes that can be used to add components and change the basic board.

The ABC system consists of a printed circuit board with circuitry designed to meet a broad range of prototyping requirements; a 2650 microprocessor; 1000 bytes of ROM that includes PIPBUG, a Signetics-developed loader, editor and debug program; 512 bytes of RAM; both serial and parallel input/output ports; and a dual monostable on-board clock.

The Signetics ABC system is available in either card form or as a kit. The card, which is completely assembled and tested, is priced at \$275 in unit quantities. The kit, which comes complete with all ICs, resistors and capacitors, is priced at \$190. Both versions are available from stock through Signetics and its authorized dis-

For further information contact Signetics, 811 East Arques Ave., Sunnyvale, CA. 94086; phone (408) 739-7700

CIRCLE INQUIRY NO. 274

The WW-1 General Purpose Wire Wrap Module

The WW-1 wire wrap board is based on the Wyle Computer Products standard 44-pin, 3.25" x 4.5" microcomputer and digital logic module configuration. The WW-1 module contains 14 rows of 20 pins each. The rows are spaced on 0.3" centers for direct insertion of any combination of most IC chips, from eight to 40 pins. Special DIP packages such as switches and relays, along with a variety of discrete components can also be inserted. Power and ground are bussed throughout the board for connection to specific pins as dictated by user needs. Also selectable for user wiring are 12 card edge test points and the 44 module input/output connections. Since no chip sockets are used and the wiring of all pins is user defined, the WW-1 can accept a wide variety of chip types and configurations. These could typically be: 35, 8 pin chips; or, 14, 14 or 16 pin chips plus 7, 8 pin chips; or 4, 40 pin chips plus 2, 14 or 16 pin chips; plus many other combinations; component density can be anything that the user desires

For further information contact WYLE COM-PUTER PRODUCTS, A Division of Wyle Laboratories, 3200 Magruder Blvd., Hampton, Virginia 23666; (804) 838-0122.

CIRCLE INQUIRY NO. 275

320H X 200V Super Dense Graphics Add-On Board to Merlin

The Super Dense Graphics is, like the rest of the MERLIN system, software programmable. When plugged into the MERLIN Video Interface. the Super Dense Graphic mode replaces the sparse graphic (80 x 100) mode and responds to sparse graphic mode commands.

The Super Dense Graphics board allows any 8k segment of computer memory (which may programmably start anywhere in memory) to be displayed as 64,000 graphics dots in a 320H x 200V graphics array. All graphic dots are located on-screen. Each graphic dot represents the state of one bit of computer memory and may therefore be individually controlled. The displayed information may be changed rapidly by altering the contents of the 8k segment of memory or, by switching to another 8k segment by programming a new starting address into the MERLIN scroll register. Horizontal, vertical, and diagonal scrolling effects are possible by incrementing or decrementing the scroll register. The displayed information is not blanked while changing the screen information due to the DMA architecture of the MERLIN Video Interface. The Super Dense 320H x 200V resolution is fine enough to allow a totally mixed character and graphics display presentation by software generation of dot matrix characters. Super Dense Graphics also functions in the normal split-screen mixed character/graphics mode of MERLIN in which the characters are hardware generated.

For further information contact MiniTerm Associates, Inc., Box 268, Bedford MA 01730; (617) 648-1200

EXPERIMENTOR™ Series Solderless Breadboard

EXPERIMENTOR™ 300 and EXPERIMENTOR 600 sockets feature extremely low cost, full fanout with .3" and .6" DIPs and snap-together vertical/horizontal interlocking.



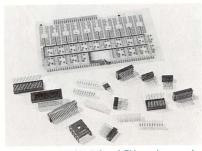
Continental Specialties Corporation, a leading manufacturer of electronic breadboarding equipment, test equipment and accessories has announced two new professional-quality solderless breadboarding sockets, which combine a number of highly desirable features, yet are "hobbyist-priced" — starting under \$10.00. Designated EXPERIMENTOR 300 and EX-PERIMENTOR 600, the new one-piece sockets both provide 94 five-point terminals, plus two 40-point bus strips, for a total of 550 solderless tie-points. EXPERIMENTOR 600, priced at \$10.95 suggested list, has a %10" center channel, making it the only socket currently on the market with full 4-terminal fan-out for microprocessors, clock chips, RAM's ROM's and other larger DIP packages. EXPERIMENTOR 300, priced at \$9.95 suggested list, has a $\frac{3}{10}$ " center channel that is perfect for smaller DIP's.

For further information contact CSC at 44 Kendall Street, Box 1942, New Haven, CT 06509; (203) 624-3103 or 351 California Street, San Francisco, CA 94119; (415) 421-8872.

CIRCLE INQUIRY NO. 277

6800 Wire Wrap Card For SWTP 6800 **Computer Systems**

The MSI Wire Wrap Card is designed to plug into the SWTP 6800 Computer Bus. The card is 9" wide by 51/2" high and contains a 44 pin connector on the top edge of the card for connections to external devices. Molex connectors attach to the bottom edge to allow the card to be plugged into the main 50 pin bus of the 6800 system.



Busing is provided for +5V. and ground as well as a position for a 7805 five volt regulator with heat sink. Additional pads are provided for the installation of discreet components. The kit is furnished with the Molex bus connectors in-

Wire Wrap Card, Model WW-1 costs \$25.00 Kit; Wire Wrap Card with 5V regulator and heat sink, Model WW-1R costs \$35.00 Kit; Wire Wrap Sockets: 14 pin, each \$.75, 16 pin, each \$.80, 24 pin, each \$1.50, 40 pin, each \$2.50.

For further information contact Midwest Scientific Instruments, 220 W. Cedar, Olathe, KS 66061; (913) 764-3292.

CIRCLE INQUIRY NO. 278

M712 Bi-Directional I/O Port

The M712 from MicroLogic is an 8-bit parallel I/O port consisting of a bidirectional data bus and four hardware-generated strobe signals (2 input, 2 output). It is a single Altair bus compatible card and will operate with all Altair/Imsai/Sol/Polymorphic CPUs.

The M712 is the simplest and most economical way to interface the DG cassette system since it was designed specifically for that purpose.

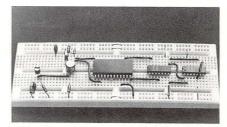
Deliveries of the M712 will begin March 1. Price is \$69.95 kit, \$79.95 assembled and tested. All MicroLogic PC boards are top-quality, plated-thru, gold-plated contacts, and all ICs are

For further information contact MicroLogic, P.O. Box 55484, Indianapolis, IN 46220; (317) 259-4289.

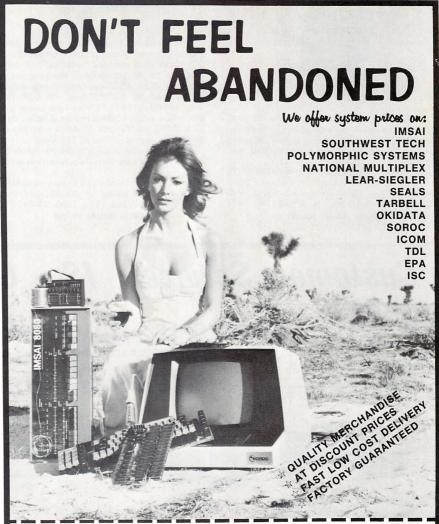
CIRCLE INQUIRY NO. 279

Super Strips Solderless Breadboards

Unlike some competitive solderless breadboards, Super Strips have a narrow center channel to accept both LSI and standard DIP packages on the same board.



The five-hole rows on each side of center represent the five tie points on each spring-clip



P.O. BOX 28106 TEMPE, ARIZONA 85282 602-894-1129





VISIT OUR RETAIL STORES:

813 N. SCOTTSDALE RD. 12654 N. 28th DRIVE ADDRESS. TEMPE, AZ. 85282 (602) 894-1129

PHOENIX, AZ. 85029 (602) 942-7300

YOUR NAME_

FOLLOWING SYSTEM PACKAGE

COMPUTER_ **OPTIONS**

MEMORIES

DISPLAYS_

MISC.

OTHERS.

STATE

QUOTE ME YOUR DISCOUNT PRICE ON THE

ASK FOR OUR FREE COMPUTER HOBBYIST BUYERS GUIDE

"terminal" within the board. There are 64 such rows on each side of center. Components and connecting wires plug directly into the spring clip tie-point behind each hole.

Eight longer groups, toward the outside, bus supply voltages and signals

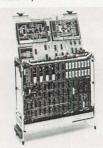
Super Strips cost just \$17

For further information contact AP Products Inc., Box 110, 72 Corwin Drive, Painesville, OH 44077; (216) 354-2101

CIRCLE INQUIRY NO. 280

Four Analog I/O Single Board Systems Mate with DEC LSI-11

A complete family of analog input/output systems, built to exactly interface with Digital Equipment's LSI-11 microcomputer, have been announced here by Data Translation Inc.



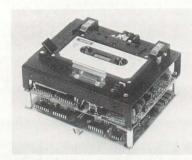
The new systems are designed to handle both industrial and laboratory applications for the popular 16 bit microcomputer. The four different systems are each built on a single quad size

All models are available in 2 to 4 weeks ARO. For further information contact Data Translation, Inc., 23 Strathmore Rd. Natick, MA 01760; (617) 655-5300, Telex 948474.

CIRCLE INQUIRY NO. 281

MFE's Option 214PAR Simplifies Computer Interface

MFE's new 8-bit Parallel I/O board Option 214PAR provides a "Universal" interface for almost all mini- and micro-computers and other parallel interfaces.



MFE Computer Access Systems' Model 250B Digital Cassette Transport with 8 bit PARELLEL I/O Board. This provides "universal" I/O compatibility for Minicomputers, Microcomputers, and other 8 bit ASCII devices. I/O provides (8) INPUT lines, (8) OUTPUT lines, (8) CONTROL lines, and (5) INTERRUPT lines. Total power ±5v and -12v. ANSI/ECMA compatible tapes, up to 32,000BPS transfer rate. 10-40ips R/W/Search, 80-120ips rewind. I/O is all TTL logic.

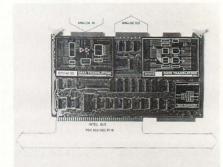
The single unit price is \$325.00. OEM discounts are available. Delivery is two-three weeks ARO.

For further information contact MFE, Keewaydin Drive, Salem, NH 03079; (603) 893-1921, TWX 710-366-1887, Telex 94-7477.

CIRCLE INQUIRY NO. 282

Single Board Analog I/O System Mates with New Intel Single Board Microcomputer

A complete single-board analog input and output system, built to be exactly compatible with Intel's new single board SBC 80/10 microcomputer, has been announced here by Data Translation, Inc.

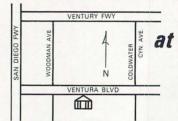


The new system, the DT1751, offers a 16 channel high speed data acquisition system, at the input, 2 Digital to Analog converter channels at the output, and a program I/O and interrupt interface to the SBC 80/10, as well as to Intel's MDS-800. The Intel microcomputer together with the DT1751 form a complete computerized data acquisition and analog output system for monitoring and control applications in industrial and laboratory processes. The DT1751 is available in two weeks ARO and is priced at \$595 in 100 quantity.

For further information contact Data Translation, Inc., 23 Strathmore Rd., Natick, MA 01760; (617) 655-5300, Telex 948474.

CIRCLE INQUIRY NO. 283

Customer Service IS Our Business!!



at PEOPLE'S COMPUTER SHOP 13452 VENTURA BLVD., SHERMAN OAKS, CA.

Systems Galore!!







4 MILLION BYTES MEMORY!!

DIGITAL GROUP Z-80 SYTEM





SPHERE 300

PEOPLE'S APPLICATION SYSTEMS:

Financial Analysis Packages Management Science Packages Accounting Packages Scientific Programs Medical Management System Available Soon

Market Tested!!

BARGAIN CORNER:

TELETYPE SC-MP KIT

\$295

HOURS:

12-9:30 PM TUE-FRI 10-6:00 PM SATURDAYS 12-5:00 PM SUNDAYS

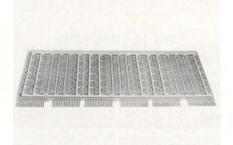
ALL CHARGE CARDS HONORED



743 KSR

12-DE-HEX Breadboard

Combining LSI and SSI parts on a single breadboard which is compatible with Digital Equipment Corporation's PDP-11 and PDP-8a mini-computers is now possible with the 12-DE-HEX.



The new board provides space for up to twenty-four 24 pin and fifty-four 14 or 16 pin integrated circuits or their equivalent, and can be furnished with sockets and wire wrap pins installed as an option.

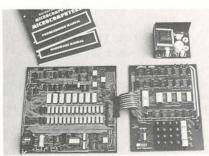
The board is made of FR-4 glass epoxy finished with a solder plate and gold connector tabs, with all holes plated-thru to a diameter of .038, and is in stock for immediate shipment.

For further information contact Douglas Electronics Inc., 718 Marina Blvd., San Leandro, CA 94577.

CIRCLE INQUIRY NO. 284

Single Board Expander Turns Single Board Computer into Micro Development System

The EBKA Single Board Expander consists of six separate functions on one circuit board that can be built in stages. The board is designed to connect directly to the system bus of any microcomputer based on a 6502 or 6800 microprocessor and is buffered to prevent bus loading.



Functions of the board are: 2 K PROM, 1702A PROM programmer, 4K RAM, PIA parallel interface, 2 ACIA serial interfaces, and a dual audio cassette adapter.

The basic kit sells for \$65.00 and includes the circuit board as well as all parts required to support 2K bytes of 1702A PROM (PROM's not included).

The 1702A PROM programmer kit includes its own high voltage power supply which mounts on the board. This kit includes operating software that allows loading and dumping of PROM's directly from the computer's memory. All commands can be supported by an ASCII or HEX keyboard. Price is \$105.00.

Separate buffers and decoders are provided with the 4K RAM kit which sells for \$180.00.

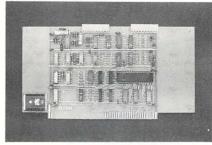
For further information contact EBKA Industries, 6920 Melrose Lane, Okla. City, Okla. 73127.

CIRCLE INQUIRY NO. 285

Single PC Card for S-100 Bus Includes Both Cassette and RS-232 Interface Circuits

GARLAND, Texas — January 12, 1977 — PerCom Data Company today introduced the first Imsai/ALTAIR compatible, dual Cassette/Terminal interface card.

Designated the CI-812, the dual function card combines interfacing functions normally requiring two or three PC cards.



The cassette interface phase encodes (Manchester/Biphase) at the KC Standard rate of 30 bytes/second, and at 60, 120, or 240 bytes/second for rapid loading of frequently used programs. In fact, the CI-812 is the only interface on the market today which provides both KC Standard and high-speed phase encoding.

The advantage of self-clocking encoding, according to Mauch, is that users can expect extremely high reliability, even at the fastest data rates, using simple, inexpensive audio cassette recorders.

The cassette interface record and playback circuits are completely independent, and the card is patterned to include optional DIP reed relays — which may be ordered as a kit — for program control of two recorder/players. This permits operations such as cross-filing.

The CI-812 companion circuit, the RS-232 terminal interface, is full duplex and provides for data exchange at 300 to 9600 baud.

The CI-812 has been designed to operate with existing user's software with little or no modification.

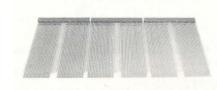
The CI-812 kit price is \$89.95. Assembled, it costs \$119.95. An instruction manual is included.

For further information contact PerCom Data Company, 4021 Windsor, Garland, TX 75042.

CIRCLE INQUIRY NO. 286

Extender Board 6-DE-HEX-C

An extender board for Digital Equipment Corporation's PDP-11 and PDP-8a minicomputers is now available.



The board is made of FR-4 glass epoxy finished with a solder plate and gold connector tabs. Sockets are glass filled alkyd with gold plated bifurcated bellows contacts.

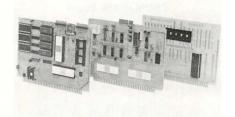
Designated the 6-DE-HEX-C, the board is available for immediate shipment from stock.

For further information contact Douglas Electronics Inc., 718 Marina Blvd., San Leandro, CA 94577.

CIRCLE INQUIRY NO. 287

F8 OEM Controller Board Set

CPU board with 1K of static ram, sockets for 4K of EROM (#800 uses 1702A's & #801 uses 2708's), 32 I/O lines, FAIRBUG TTY monitor & TTY 20mA interface, all chips are on sockets for easy repair or conversion to extended temp range chips.



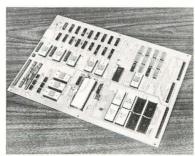
WIREWRAP PROTOTYPE BOARD with two 3861 PIO chips having 32 I/O lines, two external interrupts and two real-time clocks. Socket locations for a wide assortment of 40, 28, 24, 16 and 14 pin chips as well as transistors and trim pots for analog circuits. Top edge has holes for 3M wirewrap connectors. \$75. MOTHERBOARD with 8 72-pin connectors, power connector and daisy-chain interrupt structure. Assembled and tested for \$125. POWER SUPPLY by Lamba, 5V @ 3A, +12 & -12 @ 3A. Same size as board set for easy packaging, \$125.

For further information contact Micrologic Systems, 1201 S. Clover Dr., Bloomington, MN 55420

CIRCLE INQUIRY NO. 288

FD0300 Floppy Disk Controller

The FD0300 Floppy Disk Controller is a complete preprogrammed controller for IBM compatible disk drives. It performs control functions required to transfer data between 1 to 4 disk drives and a host system. The FD0300 also performs all formatting functions required to read and write data according to IBM 3740 specifications.



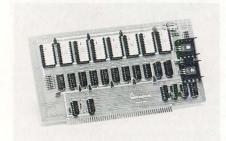
The General Purpose Host Interface interprets commands received from the host system which allow data to be addressed and transferred between the floppy disk drive and host system. The implementation of these macro level commands by the FD0300 minimizes host system interface circuitry and overhead functions.

For further information contact Scientific Micro Systems, Inc., 520 Clyde Ave., Mountain View, CA 94043; (415) 964-5700, TWX 910-379-6577.

Memory Cards

PROM/RAM Board

1K RAM, for stack storage, no need to relocate when adding memory. Room for 2K, 1702A type PROMs to store programs such as Monitors, Bootstrap Loaders and Video Drivers.



A Jump-On-Reset feature means that a PROM program can be executed at any location in memory without interfering with any other portion of memory. The board is solder masked both sides and silk screened and has its own regulators, and is S-100 bus compatible.

Optional Firmware available for use with Altair MINSAI or Polymorphic I/O boards is a 512 byte Monitor Program that reads and writes Tarbell cassette; loads and goes; verifies tape; generates sync; displays, programs and tests memory; goes to any location.

The kit, without 1702A PROMs is \$89. With the 512 Byte Monitor Program it is \$129 and \$159, depending on I/O board. An extra \$40 is charged for assembly.

For further information contact Vector Graphics[™], 717 Lakefield Rd., Suite F, Westlake Village, CA 91361; (805) 497-0733.

CIRCLE INQUIRY NO. 290

Memory Systems

The 64Ktm is a standalone memory system with greater flexibility not ordinarily available from add-in memory.

The 64Ktm comes assembled and tested with its own power supply, attractively housed in an aluminum cabinet, ready to plug into your system. Pseudo-static operation: onboard refresh clock-generator provides processor independent refresh with no wait states. The 300ns worst case access time enhances high speed operation. Power/Fail detection circuitry and battery backup provide non-volatile memory. (Batteries and Charger circuitry are optional at extra cost.) The 64Ktm is fully buffered, presenting one TTL load to the memory bus.

Compatibility with various system architectures is achieved by the use of different plug-compatible interface cards and cable, and is switch-selectable between 8080 and Z-80 microprocessors.

We currently offer digital group and ALTAIR interface cards: a plug card and cable will be furnished for the particular bus architecture specified. Memory protect is switch selectable in increments of 8K, on 8K boundaries. User has a choice of a freestanding or a rack-mountable cabinet. THIS MEMORY SYSTEM IS CAPABLE OF EXPANSION TO OTHER BIT WORD LENGTHS. The minimum complement of memory is 40K bytes @ \$1490.00; 64Ktm bytes @ \$1750.00.

For further information contact Prime Radix, Inc., P.O. Box 11245, Denver, CO 80211; (303) 422-7040.

CIRCLE INQUIRY NO. 291

DYNABYTE's \$100 Bus

A new high in S100 Bus memory cost effectiveness. Fully assembled (with sockets), tested, burned-in and guaranteed.



4Kx1 dynamic memory chips (the same ones used by the tow in IBM compatible memory systems) combined with self-contained control logic, yield a memory system with: low power consumption, total board 5 watts; transparent refresh, which means the memory looks static to the outside. No waiting. In fact, Xrdy is not even connected to the memory; full DMA capability; reliable, low level clock and control signals.

Dynabyte brings to the X-100 Bus a far superior design than what is available on the market plan today. 16K on a single board for \$485.00

For further information contact R.H.S. Marketing, 2233 El Camino Real, Palo Alto, CA 94306; (415) 321-6639.

CIRCLE INQUIRY NO. 292

Low-Power EPROM

Dallas, February 4, 1977 — Low-power, 8192-bit, ultraviolet light erasable, electrically programmable, read-only memory (EPROM) designated the TMS 27L08, has less than half the power consumption of pin-compatible devices like the TI TMS 2708 and the Intel device with the same part number.



New features incorporated in the TMS 27L08 are:

- Reduced power consumption 245 mW typical.
- Ten percent power supply voltage tolerances.
- Guaranteed dc noise immunity in both high and low states so that all inputs can be driven by Series 74 TTL circuits without use of external pullup resistors.
- Increased output drive capability (one Series 74, 74S, or 74LS TTL circuit).

For further information contact Texas Instruments, 13500 North Central Expressway, Dallas, TX 75222; (214) 238-2011, TELEX 7-3324, TWX 910-867-4702, Cable: TEXINS.

CIRCLE INQUIRY NO. 293

New 1K CMOS RAMS

Two 1,024-bit CMOS read-and-write memory components, organized into 256 four-bit words and known as the MM54C920/MM74C920 and the MM54C921/MM74C921, are now being marketed by National Semiconductor Corporation.

These random-access read-write memory devices, manufactured by state-of-the-art silicongate CMOS technology, are available in commercial and military versions and with MIL-STD-883 processing.

The MM74C920 comes in a 22-pin package and has separate Data IN and Data OUT, while the MM74C921 is an 18-pin version with common I/O. The new devices have the combined advantages of a fast access time of 250 nanoseconds for the commercial part, and low operating and standby power. "The 74C920 or 74C921 are ideal for most microprocessor POS (point-of-sale) systems, portable instruments, and electronic cash register applications. They can be used wherever battery backup is a key requirement," Livingston said.

The 74C920 has the same pin arrangement as the "2101" 1K RAM, with a strobe input to reduce power to about 3 milliwatts. In the standby powerdown mode, power consumption is only a few microwatts.

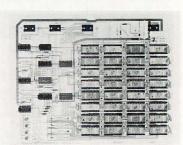
The MM74C920 and MM74C921 can be ordered directly from National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara, CA 95051, or from local distributors. The pricing is \$12.15 for 100/up quantities of the MM74C920 and MM74C921, and \$20.10 for 100/up quantities of the military temperature range parts, MM54C920 and MM54C921. Delivery is from stock.

For further information contact National Semiconductor, 2900 Semiconductor Drive, Santa Clara, CA 95051. Telephone (408) 737-5000. TWX:910-339-9240

CIRCLE INQUIRY NO. 294

Low Cost 16K X 8 Bit Dynamic Memory

WWW Enterprises announces the 16K X 8 BIT DYNAMIC RAM MEMORY board. This low cost memory has an access time of 270 nsec and a read/write time of 470 nsec.



The board is compatible with the Sphere bus but is easily interfaced to other hobbyist buses. The address lines are TTL compatible and the data resides on a bidirectional tri-state bus. The start address is selectable in 4K increments from 0 to 52K. The required voltages are +12V, +5V, and -5V. The board is fully socketed.

For further information contact WWW Enterprises, P.O. Box 548, Harbor City, CA 90710; (213) 835-9417.



San Francisco Bay Area – Where It All Started – Has Its First Home Computing Convention 7,000 to 10,000 People

7,000 to 10,000 People 100 Conference Sessions Publication of *Proceedings* Being Planned 200 Commercial & Homebrew Exhibits Special Interest Social Centers

CO-SPONSORS INCLUDE AMATEUR, PROFESSIONAL, & EDUCATIONAL GROUPS

To Be Held in the San Francisco Civic Auditorium, Northern California's Largest Convention Facility

CONFERENCE SECTIONS ON HOME COMPUTING

Being Planned

- Computer Graphics on Home Computers
- Computer-Driven & Computer-Assisted Music Systems
- Speech Synthesis Using Home Computers
- · Computers & Amateur Radio
- Computer Games: Alphanumeric & Graphic
- Personal Computers for the Physically Handicapped
- Computers & Systems for Small Businesses
- Tutorials for Hardware Novices & Software Novices
- Software Design for Personal Computers
- Microprogrammable Microprocessors for Hobbyists
- Optical Scanning for Inexpensive Program & Data Input
- Floppy Disc Systems for Home Computers
- Hardware & Software Standards for Personal Systems
- Seminars for Club Leaders, Editors, Organizers, etc.
- Personal Computers in Education (associated with a University of California short-course)

-- AND MUCH MORE --

PRESENT-WORLD & FUTURE-WORLD BANQUET SPEAKERS

Fascinating Speakers will Discuss the Past, Present, & Future Banquets to be Held in San Francisco's St. Francis Hotel

Frederik Pohl, Science Fiction Writer, & Lecturer to NASA, NY Academy of Science, etc. Robots You Can Make for Fun & Profit

John Whitney, Pioneer Computer Film Maker under grants from Natl Endow. for Arts, Guggenheim, IBM Digital Pyrotechnics: The Computer in Visual Arts Henry Tropp, Smithsonian Institution Researcher in History of Computers, & Mathematician The 1940's: The FIRST Personal Computing Era

Ted Nelson, Author, Director of the Xanadu Electronic Literary Network, & Swarthmore College Lecturer Those Unforgettable Next Two Years

GET YOUR FREE COPY OF SILICON GULCH GAZETTE

- All the news about the First West Coast Computer Faire
- Plus lots more, just to make it interesting:
 - "Hot news", & raging rumors from "Silicon Valley" (the San Francisco Bay Area)
 - Product announcements, equipment descriptions, hardware & software news and feature articles, etc.
- Details of the Proceedings of the Computer Faire
- Just write, & say: "Send me the Gazette."
 Jim Warren, Faire Chairperson
 The Computer Faire
 Box 1579, Palo Alto CA 94302
 (415) 851-7664

april 15-17, 1977 · san francisco

16K Low Power Static Memory

The 16K RAM is an exceptionally low power 16K version of the 8KM 8K Static Memory from Electronic Control Technology which is plug-in compatible with the ALTAIR, IMSAI or ECT-100 Microcomputers. It requires only a fraction of the power required by other "low power" memory boards. Less power also means less heat.

The memory IC's utilized are 4K static N-MOS RAM's with an access time of 200 nS. No wait or refresh states are required. Bus loading is only 1 low power TTL load per line used. All signals to MOS devices are buffered by low power TTL to prevent damage by static at the edge connector. The PC board has plated through holes and gold over nickel plated fingers. Low profile sockets are provided for all IC's.

For further information contact Electronic Control Technology, P.O. Box 6 Union, New Jersey 07083.

CIRCLE INQUIRY NO. 296

4K Static Memory Operates At 4 MHz and Has Bank Select

RAM card is expandable to 8 banks of 64K each or a half megabyte of memory.



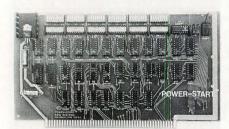
The fast 4MHz speed of the new Cromemco 4KZ RAM card is achieved by using an address anticipation strategy. Addresses are applied to the memory chips before address information appears on the address bus. In this arrangement on-board address counters are incremented at the end of each machine cycle in preparation for the subsequent cycle. The result is that proven and reliable 21LO2 low-power memory chips can be used at 4MHz.

For further information contact Joe McCrate, Cromemco, Inc., 2432 Charleston Road, Mountain View, CA 94043; (415) 964-7400.

CIRCLE INQUIRY NO. 297

New Auto-Load Board

Berkeley, CA, Feb. 11 an auto-load board, compatible with the Altair 8800, is now available under the trade mark name of Power-Start.



Basic advantages of Power-Start, are that it eliminates keying in of bootstrap programs; eliminates the need to re-set sense switches; and allows the Altair 8800 to operate without a front panel.

Because Power-Start has on-board switches that simulate the computer's front panel sense switches, terminal options need be set only once. When utilizing OEM or turn-key systems with the Altair 8800, all that is required to use Power-Start are on off and reset switches rather than a full front board.

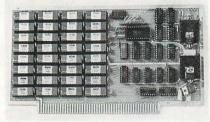
Prices for Power-Start range from \$165 for the basic kit to \$295 for the fully assembled auto-load board with ROM.

For further information contact Lewis and Associates, 68 Post Street Suite 506, San Francisco, CA 94104; (415) 391-1498.

CIRCLE INQUIRY NO. 298

16K Static RAM

Now you can get 16K of memory for your Altair/IMSAI/POLY 88 in one slot. Features fast, 200ns static RAMS, extra low power, hardware/software memory protect of each 4K, and low profile sockets for all ICs.



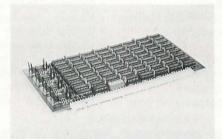
The board can be set up to interrupt when writing in protected memory and any 4K segment is addressable to any 4K slot. Optional features include a battery backup provision and a special paging capability that allows up to 1 Megabyte of addressable memory. Cost is \$459.00.

For further information contact Omni Systems, Inc., P.O. Box 7536, Univ. Station, Provo, UT 84057.

CIRCLE INQUIRY NO. 299

8K RAM Board for SWTP 6800 Computer Systems

The MSI 8K RAM Board is designed to plug directly into the main 50 pin bus of the SWTP 6800 system. The board contains 64 21L02 RAM chips to provide a total of 8,192 bytes of memory.



Four 7805 regulator packages are included on the board to provide the regulated 5V. power supply to the memory chips. A DIP switch is provided to allow the board to be strapped to any beginning 8K segment of memory. A provision for battery back-up is included to preserve memory during power failure.

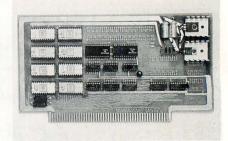
MSI 8K RAM Board, Model RAM-68 costs \$249.00. 8K RAM Board Kit, with sockets included, Model RAM-68S costs \$299.00.

For further information contact Charles C. Childress, Ph.D., Midwest Scientific Instruments, 220 W. Cedar, Olathe, KS 66061; (913) 764-3292.

CIRCLE INQUIRY NO. 300

EPROM Board for ALTAIR™/IMSAI™

Available from Mini Micro Mart is Altair/IMSAI/S100 E-PROM Board. The board permits addressing any PROM on the board anywhere within the 64K memory map — they need not be in sequential blocks. The C80-1702-2 kit is complete including all IC sockets and will hold up to eight 1702A PROMS for a total capacity of 2K. It is priced at \$49.95; delivery is from stock.



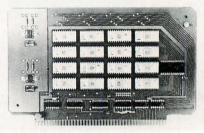
Provision is made for installing one 256 x 8 or 512×8 TI fusible link PROM, and there are spare pads provided if the user wishes to implement some circuitry of his own such as some other form of TTL PROM. The board is priced at \$49.95 in kit form and is available from stock. 2708 PROMS are available at \$59.95.

For further information contact Mini Micro Mart, 1618 James Street, Syracuse, NY 13203; (315) 422-4467.

CIRCLE INQUIRY NO. 301

4K Eprom Module is Exorciser* Compatible

The 9615 is a fully static read-only memory module specifically designed for compatibility with the M6800 microprocessor bus it is pin and outline compatible with the MEK6800D1 and D2 evaluation kits and with the Motorola Exorciser*. The 9615 features full 16-bit address decoding, fully buffered data, address, and control lines, and has a capacity of 4096 bytes of storage It is one of a family of M6800 support modules. All cards of the family are 6.05 inches by 9.75 inches and utilize a 43 pin dual readout edge connector with 0.15625 inch pin spacing.



The 9615 accomodates 1702A type erasible proms installed in sockets. The proms may be programmed or erased with external equipment. A "memory ready" signal is provided to permit the use of unselected 1702A proms if the MPU module is equipped to use such a signal.

The 9615 is priced at \$350 in single quantity and \$210 in lots of 100. Delivery is two to four weeks for factory orders, and off the shelf from authorized dealers.

For further information contact Creative Micro Systems, 5231 Loyola Ave. Westminster, CA 92683; Phone (714) 892-2859.

Trade mark of Motorola, Inc.

CIRCLE INQUIRY NO. 302

SMS 1000A ROM Simulator

The SMS ROM Simulator is a general purpose instrument that is used to replace ROMS or PROMS in a system during program debug. Because it offers real time in-circuit simulation it can be used in an engineering prototype, preproduction or production version to find and correct program errors or add new features. The ROM Simulator provides the software documentation required during debug, and RAPID, a user configured Assembler, eases program development for custom microprocessors.

The ROM Simulator is an indispensible tool for designers or ROM based systems including: Systems based on LSI processors, Systems built

with LSI bit slices, Custom processors built with MSI and LSI. And because it is a general purpose instrument, it can be used from project to project, with different processors.

For further information contact Scientific Micro Systems, Inc., 520 Clyde Ave., Mountain View, CA 94043; (415) 964-5700; TWX 910-379-6577.

Three Boards

1. Universal Board — 5400+ holes to build your own interface. Accepts any IC or module with 0.1" pin centers and greater than 0.2" row centers. Holds 94 16 pin IC's or can be modified to hold 188. Vcc and GND are distributed. Uses



two 86 pin edge connectors, two 50 pin and one 20 pin flat cable connectors and one RS232 connector.

- 16K Static RAM Board uses 2102's or equivalent. Can be configured 16K X 8 or 8K X 16 for flexibility. All necessary timing done on board.
- 3. 6 SLot Mother Board to put the other boards together.

Bare Boards: Universal — \$90, 16K RAM-\$70, 6 Slot Mother-\$25.

For further information contact Davis Laboratories, Box 2787, Santa Clara, CA 95051.

Test Equipment

Low-Cost, Autoranging Frequency Counters

Four new autoranging frequency counters offering a high performance-to-price ratio have been added to the test instrument line of Hickok Electrical Instrument Company.



The new units, Model 380 is the basic autoranging counter with 80 MHz range. No overrange is required with seven digits and autoranging. The full frequency is displayed with 1Hz resolution to 10 MHz. Above 10 MHz the decimal point shifts automatically and all digits except the least significant digit, are displayed. Provision is made for an external time base input on the rear panel. Standard time base stability is 10 ppm. Price \$259.00.

Model 380X provides the same features as the Model 380 but has a high-stability Temperature Compensated Crystal Oscillator (T-CXO) time base with 1 ppm stability for greater working accuracy and longer calibration cycle time. A time base output derived from the TCXO is available at the rear panel to drive up to four counters without TCXO. Price \$385.00.

Model 385 is the autoranging UHF frequency counter for measuring frequencies to 512 MHz. Because the UHF prescaler is built-in the decimal point is placed properly on the display over the entire range of operation, eliminating the necessity for mental calculations. The time base stability of Model 385 is 10 ppm. Provision is made for an external time base input on the rear panel. Price \$499.00.

Model 385X provides the same features a Model 385 but incorporates the high-stability TCXO time base with 1 ppm stability. This model meets FCC requirements for almost all communications frequencies. The TCXO output is available at the rear panel. Price \$625.00.

For further information contact The Hickok Electrical Instrument Company, 10514 Dupont Avenue, Cleveland, Ohio 44108. (216) 541-8060.

CIRCLE INQUIRY NO. 305

New Logic Probe Offers Shirt-Pocket Portability

The new Catch-a-Pulse Logic Probe, the most fundamental type of digital test equipment, is compatible with RTL, DTL, TTL, CMOS, MOS and Microprocessors, using a 3.5V to 15V power supply.



Thresholds are automatically programmed for multi-logic family operation. Automatic resetting memory is capable of single or multi-pulse detection. No adjustments are required. There is visual indication of logic levels, using LEDs to show high, low, bad level or open circuit logic and pulses. It is highly sophisticated and has shirt-pocket portability with a protective cap over the tip and a removable coiled cord. It eliminates the need for heavy test equipment. A definite plus in time for engineers and technicians. The price is \$29.95 plus \$1.75 for shipping and handling. A free brochure is also available.

For further information contact AVR Electronics, Box 26205, San Diego, CA 92126; (714) 455-1570.

CIRCLE INQUIRY NO. 306

Automated and Computer-Coordinated EMC Systems Span 20 Hz to 18 GHz

AMSTERDAM, NEW YORK, 19 January 1977 — A new series of Automated and Computer-Coordinated Systems for measuring EMC emissions from 20 Hz to 18 GHz has been introduced for the first time by the Electro-Metrics Division of Penril Corp.

The new array of computer-coordinated systems features the CCS-750 Computer-Coordinated version of the FSS-750 with full coverage from 10 Hz to 12.4 GHz or 18.0 GHz. Also available are reduced-range systems, the CCS-250 (20 Hz to 1000 MHz) and the CCS-500 (1.0 to 12.4/18.0 GHz). Design of the systems allows automatic computer control of the many optional peripheral devices and accessories, including programmable attenuators, antenna switching units and visual displays.

Standard operating software packages are available as options. These include modular subroutines covering completely automatic testing and data reduction by operators without special training. These modular software packages provide the user with the facility to develop many specialized programs. Alternatively, Electro-Metrics can provide complete programs covering a broad scope of sophisticated closed-loop test and measurement operations.

Prices of computer-coordinated systems depend on customer specified accessories and frequency coverage. Normally, prices range upward from \$60,000. Also available are existing non-computer Electro-Metrics instruments and systems which can be expanded to computer control at much lower cost.

For further information contact Penril, Electro-Metrics Division, 100 Church Street, Amsterdam, NY 12010; (518) 843-2600.

CIRCLE INQUIRY NO. 307

New Microprocessor Analyzer

Systron-Donner has introduced a low cost analyzer specifically to test and de-bug the software and hardware of any microprocessor system. Designated as Model 50, this tester is essentially an Address and Data Bus Monitor with hardware breakpoint capability for microprocessors.



The Model 50 is usable with all microprocessor families having accessible address and data busses up to 16-bit wide each.

Up to four Model 50 units may be interconnected for wider display, complex triggering or higher speed. The basic Model 50 operates at up to 4 MHz clock or instruction cycle rates and up to 8 machine cycles per instruction.

The Model 50 will be shown for the first time at WESCON: Booth No. 665-670. The price for the Model 50 is \$865 FOB, Concord, CA and is available in 60 days.

For further information contact Systron-Donner Corp., Concord Instrument Division, 10 Systron Drive, Concord, CA 94518. Phone: (415) 676-5000.

Power Supplies

New Power Module

Abbott has a new line of low cost AC to DC modular power supplies. The "B" series of the new NL line provides single outputs of 5V/6A, 12V/3.5A, 15V/3A, 24V/2.4A and 28V/2A. Standard input is 115 VAC, 47 to 440 Hz with 220 VAC available at no additional cost. Dual primaries are also available. All units feature tight regulation, low ripple and full load operation at 50°C ambient temperature with derating to 40% at 71°C.



The NL line also includes single, dual and triple output models with power ratings from 15 to 170 watts. Also available is Abbott's new 1976-77 Industrial Power Supply Catalog giving complete details on their power modules lines.

The price is \$49 (1-24 pieces) and delivery is normally from stock.

For further information contact Andrew Hilbert Abbott Transistor Laboratories, Inc., 5200 W. Jefferson Blvd., Los Angeles, CA 90016. Telephone (213) 936-8185, Telex 69-1398.

CIRCLE INQUIRY NO. 309

ADTECH Power Adds New Models to APS Series

Designated Model No. APS 5-9, APS 5-12, and APS 5-18, the units are considered a part of the "Black Beauty" Line.

Operating from an A.C. input line voltage of 115/230 Volts ±10%, 47-63Hz, the units exhibit a regulation accuracy of 0.1% for 50% load changes and 0.05% for ±10% line changes. Ripple is just 3mV Peak to Peak.



Prices applicable are \$57.00 for the 5V @ 9A; \$68.55 for 5V @ 12A, and \$86.35 for 5V @ 18A in quantity of 100-249. Delivery is available off-the-shelf within 2 days.

As with all APS SERIES units Adtech quarantees the new units for a period of 6 years. All of the new models feature hermetically sealed metal enclosed integrated circuit regulators, Darlington transistors, and dual rectifiers in TO-3 packages.

For further information contact ADTECH POWER, Inc., 1621 S. Sinclair St., Anaheim, CA 92806. Phone K. Nelson, (714) 634-9211.

CIRCLE INQUIRY NO. 310

Constant Voltage Power Supply Kit

A Parasitic Engineering constant voltage power supply kit can keep your Altair up even when the power line droops. It also provides high output, increased isolation from line noise and excellent over voltage protection — and it does all this at a price you can afford.

The key to this superior performance is the use of a custom-wound ferro-resonant constant voltage (C-V) transformer. The kit combines the C-V transformer with high current rectifiers and improved filtering to provide full output with the line voltage as low as 90 volts, yet up to 140 volts will not produce excessive output.

The price is only \$90 postpaid. California residents add \$5.40 sales tax.

The kit is simple to install, and comes complete with all necessary parts and detailed easy to follow instructions.

For further information contact Parasitic Engineering, P.O. Box 6314, Albany, CA 94706.

CIRCLE INQUIRY NO. 311

New DC-DC Power Source Specifically For Microprocessor Use

A new dc-dc converter which has been designed specifically for use with microprocessors and microprocessor-related IC's such as MPUS, RAMS and EROMS, has been announced by Reliability, Inc. of Houston, Tex.

Model 3W 5 R12-5 is a high performance power source, providing highly regulated +12 volts at 200ma and -5 volts at 100ma from a 5 volt DC input.



The outputs are fully short circuit protected and free of damaging turn-on and turn-off over-shoots.

Availability is stock for evaluation quantities and 4 weeks, ARO, for production quantities.

For a bulletin giving full specifications and for pricing, write or call Bob Miller, Reliability, Inc., 5325 Glenmont, Houston, TX 77036, (713) 666-3261.

CIRCLE INQUIRY NO. 312

KIM-1 Power Supply

The COMPUTERIST presents a KIM-1 Power Supply designed and manufactured by Micro-Technology Unlimited. This Power Supply follows the same pre-assembled, tested, and burned in "plug-N-go" philosophy as the KIM.

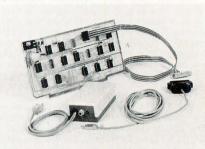
The Power Supply is completely enclosed in a Bakelite box which measures approximately 6 inches long, 4 inches wide, 3 inches high. The terminal strip and line cord exits are hidden under the box providing a neat appearance. Regulated power ratings are: +5 volts @ 1.2 amp and +12 volts @ 0.1 amp giving full use of the Kim-1 Audio Cassette capability. Additional +8 and +16 volt unregulated outputs have sufficient capacity to operate a KIM-2 4K expansion memory and other Micro-Technology Unlimited accessories. The unit is fully fused. Only \$35 from your favorite computer store.

For further information contact The COM-PUTERIST, P.O. Box 3, S. Chelmsford, MA 01824.

CIRCLE INQUIRY NO. 313

A Power Control System For The Serious User

PC3200 Power Control System, a series of components that opens up countless new applications for S-100 bus microcomputers. The system components combine to form a high quality AC power switching system that enables microcomputer control of lights, small motors, appliances, tools, etc.



Because real world power control applications are obviously external to the microcomputer, power switching devices should also be externally located. Control Logic Interfaces contain up to 32 independently addressable control channels, yet require only one output port address. A single byte output from the processor selects an individual channel, and turns it on or off without affecting the state of any other channels. Program control of PC3200 channels is straightforward, and in most systems can be accomplished with a single BASIC statement.

Three PC3200 System components are presently available — the PC3232, a 32 channel Control Logic Interface (\$299 kit, \$360 assm.), the PC3216, a 16 channel Control Logic Interface (\$189 kit, \$240 assm.), And the PC3202, a 400 watt 120 VAC Power Control Unit (\$39.50 kit, \$52 assm.).

For further information contact COMPTEK, P.O. Box 516, La Cañada, CA 91101; (213) 790-7957.

The Byte Shop reaches a new low in microcomputers. \$349

The Byt-8. It doesn't have a nifty (and expensive) front panel with lots of LED's and toggle switches.

And we obviously don't have a big full-color ad.

What we do have is the lowest priced microcomputer you can buy—built around the powerful and popular 8080A microprocessor.

For \$349, you get the complete microcomputer card, motherboard, power supply and chassis in kit form.

The Byt-8 S 100 bus is the same one used by Altair, IMSAI and most others so you have the greatest possible flexibility in choosing memory and input/output cards.

Optional cards from the Byte Shop in-

clude 4k, 8k or 16k of Random Access Memory, 4k or 8k of Programmable Read-Only Memory, a multiple input/output card, a TV typewriter card and, yes, a front panel bootstrap card, if you want the LED's and switches.

Even the CPU is optional. We'll sell you the chassis, motherboard and power supply for \$229, and you can choose your own microcomputer card—a ZPU for instance?

Byt-8. It's the new low in price, but we're aiming for a new high in flexibility, delivery and support. See the Byt-8 at your nearest Byte Shop.

BYTESHOP.

the affordable computer store

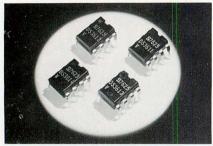
Stores now open in: Arizona, Phoenix, Tempe; California, Berkeley, Campbell, Fresno, Hayward, Lawndale, Long Beach, Mountain View, Palo Alto, Pasadena, Placentia, Sacramento, San Diego, San Francisco, San Mateo, Santa Barbara, Santa Clara, Tarzana, Thousand Oaks, Walnut Creek, Westminister; Colorado, Boulder, Englewood; Florida, Cocoa Beach, Miami; Indiana, Indianapolis; Minnesota, Eagan; New York, Levittown; Oregon, Beaverton, Portland; Pennsylvania, Bryn Mawr; South Carolina, Columbia; Utah, Salt Lake City; Canada, Vancouver, British Columbia. More Byte Shops are opening. Please write to Byte Incorporated, 1261 Birchwood Drive, Sunnyvale, California 94086.

Components

MOS-Compatible Peripheral Driver ICs

A new series of peripheral driver ICs with onetenth the input power requirement of competitive units and PNP construction for compatibility with MOS circuits is now available from Signetics.

Designated DS 3611 through DS 3614, the new units are rated for 80-volt breakdown in the off-state and a current rating to 300 milliamps per driver in the on state. The units feature high voltage PNP inputs compatible with PMOS, CMOS, TTL or DTL circuits. Required input current for the series is 40 microamps for a logic input (logical "1") of 2.4 volts.



The new peripheral driver ICs incorporate input clamping diodes for circuit protection. All units in the series are dual drives; DS 3611 is "and," DS 3612 is "nand," DS 3613 is "or" and DS 3614 is "nor."

The pin out arrangement for the 3611-3614 series is identical to industry standard 75451 through 75454 drivers ICs. However, breakdown voltage is significantly higher and drive power loading factor is one-tenth that of the industry standard devices.

The DS 3611-DS 3614 peripheral drivers are immediately available from stock through Signetics and its authorized distributors. Price for the new units is less than \$1.00 in OEM quantities

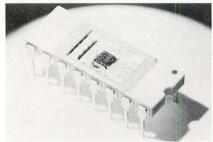
For further information contact Signetics, 811 East Arques Ave., Sunnyvale, CA. 94086; phone (408) 739-7700.

CIRCLE INQUIRY NO. 315

New 8-Bit D/A Converter

A new series of high-speed multiplying digitalto-analog converters with direct interface to TTL, ECL, HTL, MOS and PMOS logic families is now available from Signetics.

Designated NE 5007/8 and SE5008, the new converters incorporate advanced circuit design that achieves 85-nanosecond settling time and high swing, adjustable threshold logic inputs to provide full noise immunity.



Typical applications include converters for servo motors, pen drivers, waveform generators, audio encoders and attenuators, analog meter drivers, programmable power supplies, CRT display drivers, high speed modems and many other applications where low-cost and high speed D/A conversion is required.

Power supply range is from ± 4.5 volts to ± 18 volts with essentially unchanged performance over the range. The convenient 16-pin plastic DIP package and power consumption of 33 milliwatts with a ± 5 volt supply makes the 5007/8 converters ideal for use in portable equipment and for military/aerospace applications.

The 5007/8 units offer dual complementary outputs that permit differential operation, effectively doubling the peak-to-peak output swing. Output compliance is from -10 volts to +18 volts.

The new NE5007/8 and SE5008 converters are available from stock through Signetics and its authorized distributors. Prices in quantities of 100 are \$3.45 for NE5007 and \$3.95 for NE5008.

For further information contact Signetics, 811 East Arques Ave., Sunnyvale, CA 94086; phone (408) 739-7700.

CIRCLE INQUIRY NO. 316

New Low-Power Schottky Registers

Two new low-power Schottky shift registers with gated serial inputs are now available from Advanced Micro Devices.

The Am25LS164 and Am54/74LS164 are 8-bit serial-in/parallel-out shift registers offering guaranteed maximum clock frequencies of 35MHz and 25MHz respectively. In addition, the Am25LS164 offers improved noise margin and twice the fan-out over the military temperature range compared with the Am54/74LS164.

The gated input provides enable/disable control over incoming data. Additionally, these devices offer an asynchronous clear input to simultaneously clear the devices' eight flip-flops.

Prices for the Am25LS164 start at \$1.42 in 100-piece lots nationally from Hamilton/Avnet, Schweber or Cramer Electronics and regionally from Arrow, Bell and Century Electronics.

For further information contact E. Sopkin, Advanced Micro Devices, Inc., 901 Thompson Place, Sunnyvale, CA 94086; (408) 732-2400.

CIRCLE INQUIRY NO. 317

New Analog Switch Series

A new series of analog switches developed by National Semiconductor Corp. combines bipolar and JFET technology, producing the industry's first single-chip quadruple JFET switches. Combined with this new monolithic process is a unique circuit technique that allows the new analog switches to maintain a constant resistance over the wide analog voltage range of +10 volts.

Designated the LF11331, LF11332, LF11333, LF11201, and LF11202, the new analog switches are designed to operate from minimum TTL input levels and feature a break-before-make switching action. The LF11331 contains four normally-open switches with a common disable pin that opens all of the switches in the package. The LF11332 contains four normally-closed switches with a common disable. The LF 11333 contains two normally-closed switches and two normally-open switches with a common disable. The LF11201 has four normally-closed switches, and the LF11202 has four normally-open switches.

For further information contact National Semiconductor Corp., 2900 Semiconductor Drive, Santa Clara, CA 95051; Telephone (408) 737-5000, TWX: 910-339-9240.

CIRCLE INQUIRY NO. 318

QUAD TTL-TO-MOS Driver

Dallas, February 3, 1977 — The SN75355 accepts standard TTL and DTL input signals and provides high current and high voltage output levels suitable for driving MOS circuits. It may be used to drive address, control and time inputs for several types of MOS RAMs or microprocessor multiphase clock inputs.



The SN75355 operates from the TTL 5-volt supply and the MOS Vss (Vcc2) and Vbb (Vcc3) supplies in many applications. It has been optimized for operation with the Vcc2 supply voltage from 12 to 18 volts and with nominal Vcc3 supply voltage from three to four volts higher than Vcc2.

The driver is a high speed version of the SN75365 type device and requires lower Vcc2 voltage. It is characterized from 0° to 70°C operation and is available in 16-pin plastic and ceramic dual-in-line packages.

Prices for each part in 100-piece quantities are \$2.54, plastic, and \$3.25, ceramic.

For further information contact Texas Instruments Incorporated, Inquiry Answering Service, P.O. Box 5012, M/S 308 (Attn: SN75355), Dallas, TX 75222.

CIRCLE INQUIRY NO. 319

A Static 16-Word Asynchronous Memory

A universal Schottky-clamped 16-word 5-bit TTL buffer memory has been introduced by Texas Instruments Inc. Designated the SN74S225, the static bipolar First-In/First-Out Memory is intended to interface directly between two different digital systems, or subsystems, that operate at different data rates, such as keyboard-to-disc, CPU-to-memory or peripherals.

Functional capabilities include: independent synchronous inputs and outputs. DC to 10 MHz input or output data rates, 3-state data outputs, two independent clock circuits.

In the 20-pin plastic DIP and rated for temperatures from 0° to 70°C, the SN74S225N sells for \$4.50 in quantities of 100 pieces.

The SN74S225J in a 20-pin ceramic DIP is rated for 0°C to 70°C and sells for \$5.63 in quantities of 100. Delivery in OEM quantities is two to eight weeks ARO.

For further information contact Texas Instruments, Inc., Inquiry Answering Service, P.O. Box 5012, M/S 308, Dallas TX 75222. For marketing information contact Gerald McGee at (713) 494-5115 (ext. 2621).

XIMEDIA PRESENTS

The SOROC IQ120

CURSOR CONTROL. Forespace, backspace, up, down, new line, return, home, tab, PLUS ABSOLUTE CURSOR ADDRESSING.

TRANSMISSION MODES. Conversation (half and full Duplex) PLUS BLOCK MODE — transmit a page at a time.

FIELD PROTECTION. Any part of the display can be "protected" to prevent overtyping. Protected fields are displayed at reduced intensity.

EDITING. Clear screen, typeover, absolute cursor addressing, erase to end of page, erase to end of line, erase to end of field.

DISPLAY FORMAT. 24 lines by 80 characters (1,920 characters).

CHARACTER SET. 96 characters total. Upper and lower case ASCII.

KEYBOARD. 73 keys including numeric key pad.

REPEAT KEY. 15 cps repeat action.

DATA RATES. Thumbwheel selectable from 75 to 19,200 baud.

SCREEN. 12 inch rectangular CRT — P4 phosphor.



SPECIAL INTRODUCTORY PRICING

Kit \$ 995.00

Assembled \$ 1,295.00

(Price includes block mode, lower case and 24 line options.)

IMSAI + Z-80

XIMEDIA is offering a special price on an IMSAI I-8080 with a TDL ZPU Z-80 board instead of the standard 8080 cpu.

The system includes:

IMSAI I-8080 without cpu board. 22 slot mother board with 22 *pre-soldered* connectors and card guides; cooling fan.

Price:

Kit

Assembled

\$ 999.00

\$ 1,295.00

XIMEDIA OFFERS A FULL RANGE OF PRODUCTS FOR THE PERSONAL COMPUTER ENTHUSIAST AND THE SMALL SYSTEM DESIGNER. LET US QUOTE ON ALL YOUR HARDWARE AND SOFTWARE NEEDS.

OUR RETAIL STORE - THE COMPUTERIST tm - IS NOW OPEN IN SAN FRANCISCO. CALL US FOR DIRECTIONS.

Selectric Terminals \$1,200.00

AT LAST!

An <u>ASCII</u> coded Selectric terminal with a RS232-C interface.

Call or write us today for details.

XIMEDIA

1290 24th Avenue • San Francisco, CA 94122

(415) 566-7472. Please call collect!

California residents add 6% sales tax. Please allow 3 weeks for delivery.

TI Announces Low Power Schottky RAMs

Four new low power Schottky RAMs have been added by Texas Instruments to its bipolar memory product line.

Designated SN74LS214 and SN74LS314, the 1024 x 1 low power Schottky Ram is available in both three state and open collector versions, respectively. Designed for applications where high performance and minimum power dissipation are required, these devices can significantly improve speed vs. power performance of designs using older 1024 bit RAMs.

The 74LS200A/LS300A are three state and open collector versions of the 256 x 1 low power Schottky RAM. Suitable for local store and buffer memory applications, these devices provide a superior speed vs. power product where power dissipation is a major consideration.

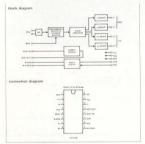
Priced at \$17.60 each in 100 pc. and up quantities, the 74LS214/LS314N is available from stock to eight weeks. The 74LS200A/LS300AN is priced at \$3.60 each in 100 and up quantities with delivery from stock to eight weeks. All of these devices are available in plastic (N) and ceramic (J) DIP packages.

For further information contact Texas Instruments Incorporated, Inquiry Answering Service, P.O. Box 5012, M/S 308 (Attn: Low Power Schottky RAMs), Dallas, TX 75222. For marketing contact: Bob West (713) 494-5115, ext. 2621.

CIRCLE INQUIRY NO. 321

Microcomputer Clock Generator

A clock generator designed for use with the 4004 family of microcomputers is now available from National Semiconductor Corporation. Known as the DP4201, this device satisfies the signal requirements for 4004 and 4040 microprocessor components in the Four-Bit Integrated Processing System (FIPS), and in MCS-4® and MCS-40® microcomputer based systems.



The clock generator has an operative frequency range from dc to 6MHz and is available in either a ceramic dual-in-line package (DP4201-J) or a molded epoxy plastic dual-in-line package (DP4201-N) from National Semiconductor and its distributors. When purchased in lots of 100, the unit price is \$4.50 for the epoxy package and \$5.10 for the ceramic package.

For further information contact National Semiconductor, 2900 Semiconductor Drive, Santa Clara, CA 95051; (408) 737-5000; TWX: 910-339-9240.

CIRCLE INQUIRY NO. 323

Develop D/A Converter Series

Sunnyvale, CA ... A series of three highspeed, monolithic digital-to-analog converters particularly suited for applications within the data acquisition and communications markets are now available from Advanced Micro Devices.

These circuits — DAC-08, Am1508 and SSS1508A — are designed as plug-in replacements for like-numbered devices from other manufacturers. These parts, as with all units from Advanced Micro Devices, undergo 100 percent processing to the requirements of MIL-STD-883.

For further information contact Advanced Micro Devices, Inc., 901 Thompson Place, Sunnyvale, CA 94086; (408) 732-2400.

CIRCLE INQUIRY NO. 322

2 Amp to 50 Amp Bridge Assemblies have Underwriters Recognition

A family of 2 Amp to 50 Amp, full-wave single-phase bridge assemblies with peak inverse voltage ratings from 50V to 1000V have recently received recognition from Underwriters Laboratories, Inc. Designated the SDA-117, -129, -130, -132, and -138 series by Solid State Devices, Inc., the bridges are applied in a broad range of industrial and commercial equipment.



Recognized components meet certain conditions of acceptability that aid in qualifying equipment for U.L. approval. When used in acceptable combinations with other elements, the SSDI bridges do not require individual certification.

The SSDI bridges have peak inverse voltages of 50V, 100V, 200V, 400V, 600V, 800V, and 1000V. The 2 Amp SDA-117 and 5 Amp SDA-138 assemblies are packaged in 0.6 inch square by 0.2 inch high thermal-conductive epoxy cases. Peak recurrent forward surge current is 10A and 30A respectively. At 2 Adc, the SDA-117 exhibits 1.2V forward voltage drop while the SDA-138 exhibits 1.1V. Maximum reverse leakage is $2\mu\rm{A}$ per leg at 25°C.

The SDA series full-wave single-phase bridge assemblies are priced from \$2 each to \$10 each in 100 piece quantities. Delivery is from SSDI stock.

For further information contact Solid State Devices, Inc., 14830 Valley View Ave., La Mirada, CA 90638; (213) 921-9660, TWX (910) 583-4807.

CIRCLE INQUIRY NO. 323

A New "Sample-and-Hold" IC

A monolithic "sample-and-hold" IC accurate within 0.01 percent has been designed and developed by the Advanced Linear IC Operation of National Semiconductor Corp., utilizing the company's new BIFET technology.

The BIFET process provides a combination of bipolar transistors and P-channel field-effect transistors on the same silicon chip, which is ideal for fabricating a "sample-and-hold" circuit.



Known as the model "LF198," the new "sample-and-hold" circuit offers the speed and accuracy of 6 microseconds to 0.01 percent.

Some of the operational characteristics of the LF198 are shown below.

Acquisition time to 0.01% ($C_h = 1000 pF$): $6\mu Sec$;Offset Voltage: 1mV; Input Current: 20nA; Gain Accuracy: 0.002%; Hold Step ($C_h = 0.01\mu F$): 0.5mV; Input Impedance: 20G ohms; Power Supply Rejection: 100dB; Output Noise: 25nV/ Hz; Droop Rate ($C_h = 0.01$): 3mV/Sec.

Applications of the new "sample-and-hold" include multiplexers, "A to D" and "D to A" converters, integrators, correlators, reset stabilizers, and analog computation.

The LF198 is available in an 8-pin TO-5 package and is specified over the military temperature range of -55°C to $+125^{\circ}\text{C}$; the LF298 and LF398 are rated over -25°C to $+85^{\circ}\text{C}$, and 0°C to $+70^{\circ}\text{C}$ respectively. Availability is from stock. When purchased in lots of 100, the LF398 sells for \$3.65 each.

For further information contact National Semiconductor, 2900 Semiconductor Drive, Santa Clara, CA 95051; (408) 737-5287, Mr. Roy Twitty.

CIRCLE INQUIRY NO. 324

New Dual Differential Line Driver Circuit

Texas Instruments, Inc., has announced a new dual differential line driver circuit which meets the Electronic Industries Association's RS422 specification.

Designated the SN75158, it features single 5V supply, short circuit protection and input clamp diodes.

Inputs are standard TTL. The outputs provide differential signals with high current capability for driving balanced lines, such as twisted-pair types, at normal line impedance without high power dissipation. The output stages are TTL totem-pole types featuring a high impedance state in the power off condition.

The SN75158 is characterized for a 0° to 70°C operating temperature range. It is offered in either plastic or ceramic 8-pin dual-in-line

packages

The plastic version is priced at \$2.12 each in quantities of 100 and is available from TI distributors now. The ceramic version will be available soon.

For further information contact Texas Instruments, Inc., Inquiry Answering Service, P.O. Box 5012, M/S 308 (Attn: Dual Line Driver), Dallas TX 75222. For marketing information contact Dale Pippenger at (214) 238-3527

CIRCLE INQUIRY NO. 325

Dual ECL-to-MOS Drivers

Texas Instruments, Inc. has announced two new dual ECL-to-MOS drivers, designated the SN75320 and SN75321. These new devices are functionally similar to the TTL compatible SN75322.

Both are monolithic ECL-to-MOS driver interface circuits which accept standard input signals from Series 10,000 ECL and similar families. They provide high-voltage output levels suitable for driving MOS circuits.

Due to the low power dissipation when the driver output is at a low level, these circuits are ideal for driving N-channel devices such as the TMS4030 4K RAM.

The SN75320 requires an externally generated ECL input reference voltage while the reference in the SN75321 circuit is fixed internally at -1.3V. Both devices are characterized for operation from 0° to 70° C.

The two circuits are offered in 14-pin dual-inline plastic and ceramic packages. Prices for each part in 100-lot quantities are \$2.75 for plastic and \$3.53 for ceramic. The plastic versions are now available and the ceramic will be available soon.

For further information contact Texas Instruments, Inc., Inquiry Answering Service, P.O. Box 5012, M/S 308, Dallas TX 75222.

For marketing information contact Dale Pippenger at (214) 238-3527.

CIRCLE INQUIRY NO. 326

TI Reduces MOS Plastic 4096 Bit RAM Prices

Texas Instruments announced price reductions on plastic-packaged 4K X 1 MOS RAMs effective Jan. 1.

According to a Texas Instruments spokesman, the new prices reflect increased high-volume N-channel plastic package production experience. Each dynamic RAM type is available in three speed ranges, and each is fully TTL compatible

with MOS level clocks except for the 4051 Series which has a TTL level clock.

Separate input/output types in 22-pin packages: TMS 4030/4060 NL with maximum access time of 300 nsec, at the reduced price of \$7.66; TMS 4030-1/4060-1 NL, 250 nsec, \$9.47; TMS 4030-2/4060-2 NL, 200 nsec, \$11.30.

Common I/O types in 18-pin packages for BUS oriented systems: TMS 4050/4051 NL, 300 nsec, \$7.66; TMS 4050-1/4051-1 NL, 250 nsec, \$9.47; TMS 4050-2 NL, 200 nsec, \$11.30.

These dynamic RAMs are all available from stock at TI or from authorized TI distributors.

For further information contact Texas Instruments, Inc., P.O. Box 5012, Dallas, TX 75222.

CIRCLE INQUIRY NO. 327

Low-Cost OP Amp Triples Frequency Range

A dual operational amplifier with the characteristics and package options compatible with the "industry standard" MC1558/MC1458, but with nearly three times its unity-gain bandwidth has been introduced by Motorola.



Designated MC4558/MC4558C, the new devices can be plugged directly into sockets of existing designs, currently using MC1558/1458 types, in order to expand the unity-gain bandwidth of the circuits from 1 MHz to 2.8 MHz without affecting other characteristics. And they are ideal for new designs whose required bandwidth previously prohibited the use of low-cost operational amplifiers.

For further information contact Motorola, Inc., P.O. Box 20912, Phoenix, AZ 85036; (602) 244-6900.

CIRCLE INQUIRY NO. 328

New .4" High, Two-Digit LEDs

Industrial Electronic Engineers, Inc. (IEE) is now offering .4" high, two-digit LEDs designated as IEE-HERCULES Series 1780/1790.

Series 1780/1790, also known as "The Gemini Twins" are composed of two, .4" high digits (0-9) with individual right hand decimal points and are integrally packaged in a single, compact unit. These LEDs are available in common cathode or common anode design with typical 250μ cd/segment luminous intensity at 20mA/1.6V.



In the 10,000 piece quantity, these LEDs cost \$1.66 each. Delivery is off-the-shelf. Detailed dimensional specifications are illustrated in IEE's Product Profile on Series 1780/1790 and is available free upon request to: IEE, 7740 Lemona Avenue, Van Nuys, CA 91405, (213) 787-0311, attn: Bob Brandt, ext. 268.

CIRCLE INQUIRY NO. 329

Add Three-State Decoders

A m 2 5 L S 2 5 3 7, A m 2 5 L S 2 5 3 8 and Am 2 5 L S 2 5 3 9 — all offer three-state outputs for use in bus oriented systems. In addition, they feature a buffered common polarity control, which permits the outputs to be selected mutually exclusive active/low or mutually exclusive active/how or mutually exclusive active/high under control of the POL input. They are available in the recently introduced 20-pin dual-in-line package for increased circuit board density.

The Am25LS2537 is a one-of-ten decoder/demultiplexer, which accepts four active high BCD inputs and selects one-of-ten mutually exclusive outputs. The Am25LS2538 is a three-line to eight-line decoder/demultiplexer that has three buffered select inputs that are decoded to one-of-eight outputs.

The Am25LS2539 is a dual two-line to four-line decoder/demultiplexer with two buffered

select inputs that are decoded to one-of-four out-

All three circuits are available in molded and ceramic hermetic packages or ceramic flat packages and, as with all integrated circuits from Advanced Micro Devices, undergo 100 percent processing to the requirements of MIL-STD-883.

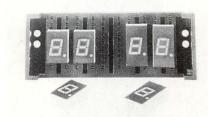
Prices for these decoders start at \$2.55 in 100-unit lots.

For further information contact Advanced Micro Devices Inc., 901 Thompson Place, Sunnyvale, CA 94086; (408) 732-2400.

CIRCLE INQUIRY NO. 330

New .3" High LED Digital Displays

Industrial Electronic Engineers, Inc. (IEE) has announced the newest addition to their line of LEDs — IEE-HERCULES Series 1775/1776 .3" High LED Digital Displays.



Series 1775/1776 are .300" high, deep red characters, 0-9 with right hand decimal point. Series 1775 is the common cathode design, with the common anode version is Series 1776. Among some of the features of these new LEDs are: single plane, wide angle (160°) viewing, high contrast ratio, GaAsP emitting material for maximum current to brightness efficiency, slimline configuration with 10 or 14-pin, DIP connections on .300 spacing and typical 350 µcd per segment luminous intensity at 20mA/1.6VF.

Installation is quick and simple in integral multi-digit (2 through 8) arrays with IEE-ATLAS Series 1750/51 Universal Display Mounting Hardware. Series 1775/76 sells for \$.85 each in the 10,000 piece quantity. Delivery is off-the-shelf.

Additional mechanical, electrical and performance characteristics, together with diagrammed pin assignments are described in Product Profile IEE-HERCULES Series 1775/1776 and is available free upon request to: IEE, 7740 Lemona Ave., Van Nuys, CA 91405, attention: Bob Brandt, product sales manager, (213) 787-0311, ext. 268.

CIRCLE INQUIRY NO. 331

Literature

Free Catalogue of New ACM Cassettes

New audio cassettes are being released by the Association for Computing Machinery. They contain selected presentations from the ACM 75 Annual Conference held in Minneapolis, Minn.

A free catalogue describing all ACM cassettes is available from: Information Cassettes, Dept. ACM, 645 N. Michigan, Chicago, IL 60611; phone (312) 944-2120.

These ACM cassettes feature such topics as: Structured Programming, Data Bases, Software Development, Networks, Minicomputers, and Management. Also included is the prestigious A.M. Turing Award Lecture.

These professionally edited presentations are on high-quality, low-cost standard audio cassettes. Featured are industry leaders who have specialized knowledge and important insights in-

to critical areas. Most are not available in any proceedings, and each speaker has reviewed his recording for completeness and accuracy.

Learning by listening with economical audio cassettes is a proven educational method used throughout industry with great success. They can aid in teaching employees or students, and are convenient to use at work, at home, while commuting, or on a business trip.

The entire ACM audio library contains over 180 speakers on the 49 cassettes from 4 ACM International Conferences. The A.M. Turing Award Lectures from 1972 through 1975 were recorded. A complete catalogue is now available from Information Cassettes at the above address.

For further information contact Information Cassettes, Inc., 645 N. Michigan Ave., Chicago,

CIRCLE INQUIRY NO. 332

S-100 Crate Design Information Package

The objective design crate information packet is a complete set of plans and specifications for building an S-100 compatible card file and power supply. The crate is of high quality, making use of standard, commercially available extrusions, card guides, and power supply components. The design is variable and can be adapted to any of the available S-100 mother-boards.

The advantages of constructing a crate as opposed to buying one include: cost savings (the crate and power supply will cost approximately \$150, assuming all major components are purchased in unit quantities); a sturdier crate; easier to work with design; and opportunities to meet special crate needs by customizing.

For the commercial interest, the crate design can be the basis for in-house computer construction. For the hobbyist, the home constructed crate is a money-saving way to get started in personal computing.

To order the S-100 crate design information packet, mail a check or money order to Objective Design, Inc., P.O. Box 20456, Tallahassee, FL 32304. Cost is \$19.95 plus 4% sales tax for Florida residents. Postage prepaid on all items for U.S. delivery.

CIRCLE INQUIRY NO. 333

VADIC offers new 24 page modem catalog

An expanded 24 page catalog, covering products and services, is now available from VADIC, major manufacturer of low and medium speed data modems.



The catalog includes technical information on VADIC's line of Bell, IBM, and CCITT compatible modems, covering a range of 300, 1200 and 2400 bps, the VA3400, a unique full duplex 1200 bps modem that can operate on dial-up or two wire dedicated lines, Multiple Data Sets with extensive displays and diagnostic capability, automatic dialing units, and multiple calling systems.

For further information contact The VADIC Corporation, 505 East Middlefield Road, Mountain View, CA 94043; (415) 965-1620.

CIRCLE INQUIRY NO. 334

Personal Computing Directory

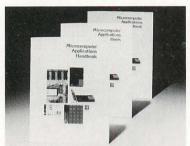
The Personal Computing Directory will contain names, addresses, telephones, descriptive keywords, and other information, about people, clubs, societies, associations, organizations, newspapers, newsletters, book publishers and distributors, magazines, manufacturers, equipment distributors, mail order services, kit vendors, software developers, maintenance and repair services, convention and meeting organizers, credit and non-credit courses, lectures, clinics, demonstrations, tours, contests, flea markets, in a word-everythingrelatedtothepersonalcomputingfield! The directory will have three main parts. The first, a geographical, or zip code sorted listing, will consist of each name, address, telephone, and descriptors, listed in zip code order, and alphabetically within a zip code. Similar zip codes tend to be near each other, so you need only look for your own zip code to find people and organizations near you. The second part will be an alphabetically sorted list of people (last name first) and organizations. If you don't know the address, look up the name. The third part will be a subject listing, sorted alphabetically. Look up your subject and find people and organizations with similar interests. You can get listed for free by filling out the attached form and returning it to the Personal Computing Directory address. Permission to copy this form, and distribute it, is granted. Please note the space for a 'System Name." This directory will serve as a registry for people who would like to have a unique name for their system. It will be analogous to call numbers used by radio amateurs. I would like to suggest something like the following: "Concertina6800NH," where Concertina might indicate a music system based on the Motorola 6800 chip, and NH indicates it is located in New Hampshire. I will assist in the resolution of same-name conflicts. Please try to list at least two interests, and while there is no theoretical upper limit (just a space and patience limit), I will do some "pruning" to restrict the size of some listings. Please note that if you want to be on the directory list, but not the mailing list, someone may still use your name. They will be considered rats! So, copy the form, send it to friends, fill one out for yourself, send it in, and hurry on down to your local computer store (or order from the *Personal Computing Directory* address) to buy the 1977 edition of the directory! The price will be a mere \$4.95, for a 200+ page, 8½ by 11 inch paperback, black and white, available about April 1, 1977.

For further information contact Personal Computing Directory, Box 134, Harvard Square, Cambridge MA 02138; (617) 354-1216.

CIRCLE INQUIRY NO. 335

Microcomputer Application Handbook for 8080A Based Systems

A new 144-page microcomputer applications handbook for lasis Inc. explores the advantages and applications of microcomputers in general, with particular emphasis on 8080 based systems.



Throughout the handbook extensive use is made of tables, diagrams and schematics to supplement the text material. The text is written in a manner which leads the reader through all important decisions, appraising him of all tradeoffs and pitfalls in designing operational systems. The applications handbook thoroughly discusses the design and operation of microcomputers and the roles of OEM and development systems. Also included in the handbook is a complete hardware design casebook which takes the reader through an actual system design. Considerable attention is paid to designing system monitors, text editors and assembler programs. The handbook contains complete information on the architecture and all 78 instructions of the 8080 CPU.

The lasis Microcomputer Applications Handbook is available immediately in 1-99 quantities for \$7.95.

For further information contact lasis Inc., 815 W. Maude Ave., Sunnyvale, CA 94086; (408) 732-5700.

CIRCLE INQUIRY NO. 336

ON_LINE, Classified Ads for Hard- & Soft- Wares

ON_LINE is now smaller (type style) in order to be larger (content), ON LINE is mailed First Class every three weeks and, since the U.S. Postal Service charges by the ounce, the new format was designed to fit the contents of up to 20 letter-size pages in a .94 oz. package. ON_LINE contains buy, swap & sell classifiedformat advertisements submitted by individual computer hobbyists, as well as by small and large commercial enterprises, pertaining to items of interest to hobbyists and other users of microcomputer systems. ON_LINE also contains New Product Announcements and computer club meeting schedules. Frequent publication and an ad deadline only 4 days before mailing insures up-to-date content. Ad rates as low as \$1.50 per 96-character line for non-commercial ads. 18-issue subscription (1 year) -\$3.75. Free sample issue sent on request, or added to subscription.

For further information contact ON_LINE, 24695 Santa Cruz Hwy., Los Gatos, CA 95030.

CIRCLE INQUIRY NO. 337

MMD-1 Microcomputer Brochure

An 8-page brochure describing the Mini-Micro Designer, MMD-1 education and development microcomputer and its optional accessories is available from E&L Instruments.

Based on the 8080A 8-bit microprocessor, the MMD-1 is a complete self-contained computer in a desk-top case with a convenient keyboard. Simple enough for "hands-on" self-instruction or classroom use, it is also a low-cost software and systems development aid for the hobbyist as well as the professional circuit designer.



This illustrated brochure contains descriptions and block diagrams of the MMD-1 and its addon memory interface board. In addition, the topics covered by the included microcomputer programming and interfacing course are listed. Prepared specifically for use with the MMD-1, the comprehensive text is adapted from E&L Instruments' proven self-teaching Bug-book series.

Copies of the MMD-1 brochure are available from E&L Instruments, Inc., its representatives and authorized dealers.

For further information contact E & L Instruments Inc., 61 First Street, Derby, CT 06418; Telephone (203) 735-8774; Telex 963536.

CIRCLE INQUIRY NO. 338

Catalog on Custom and Standard I.C. Packaging Products

Scanbe has introduced a new 28-page catalog that describes the company's line of l.C. packaging products. The catalog includes detailed information on socket cards and panels, card files and packaging drawers, dual-in-line ME-2 sockets and pin strips, connectors, kit cards, extender and cable termination cards, as well as a wide complement of l.C. packaging accessories.

For a copy of the new I.C. Packaging Catalog, write or call Scanbe, 3445 Fletcher Ayenue, El Monte, CA 91731. Telephone (213) 579-2300.

CIRCLE INQUIRY NO. 339

ia515 Microcomputer Programmed Learning Course

The lasis programmed learning series comes in six easy-to-follow volumes along with all associated design aids. This complete course combines the most effective methods of self instruction ever developed with all the technical information necessary to design a wide variety of sophisticated microcomputer systems.

The continuous learning and motivation through questions and answers is the heart of programmed learning. The lasis course uses this stimulating technique in a way that causes the reader to devote his full attention to the entire course.

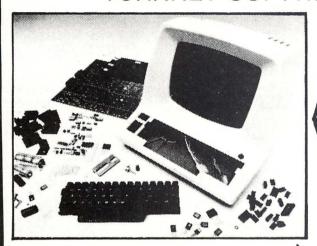
As a bonus lasis offers a free Microcomputer Applications Handbook to subscribers of the ia515 course. This handbook covers actual OEM system design and development and a multitude of applications for 8080 based systems.

For further information contact lasis Inc., 815 West Maude Ave., Sunnyvale, CA 94086; (408) 732-5700.

Disc/3

COMPUTER SUPERMART

TURNKEY SOFTWARE SPECIALISTS



EASY

TO ASSEMBLE

Lear-Sigler ADM-3 terminal kit with NEW DCA (direct cursor addressing) 24 lines x 80 characters; 64 ASCII upper characters, plus punctuation and control; 5 x 7 dot matrix; EIA standard RS232C and 20mA current-loop (switch selectable).

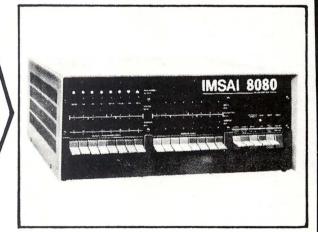
\$849.95* with DCA

FAST

MICROPROCESSOR

IMSAI 8080 microcomputer, top of the line; rugged industrial quality; 28 amp power supply; 22 slot mother board; fully expandable to 64K; will support floppy disk drive, terminal, audio-tape cassette input device, 300 lpm printer.

\$659.95*



Look to DISC/3...authorized distributors for IMSAI, Lear-Sigler, Cromemco, Z-80, Centronics Data Computer, Digital Equipment Corp., and Data General Corp. We also carry TDL.

Disc/3

1840 Lincoln Blvd., Santa Monica, Calif. 90404 Store hours

Monday-Friday 8:30-5:30

*Prices subject to change.

RUSH	ORDER FORM	1 - or Call	Disc/3 (213)	451-8911
		KIT*	ASSEMBLED	TOTAL
ADM 3-K wi	th DCA (24 x 80)	\$849.95	\$1099.95	
	microsystem	\$659.95	\$999.95	
	ns please add sa			
	my _ cashiers	check, 🗌 m	ioney order, \square	personal check,
☐ \$100 dep	osit for C.O.D.	Signature_		
□ BankAm	ericard NO			
☐ Master C	harge NO		Expires_	
				we honor
BANKAMERICARD	NAME	ADI	DRESS	master charge
BANKAMENICAND				THE INTERBANK CARD
Charles Bally	CITY	STATE	ZIP	

1976-77 Power Supply Catalog

ATL's new 60 page 1976-77 catalog is now available. This free catalog lists over 3,500 standard power supply modules with complete electrical specifications, operating parameters, dimensional charts, and prices from 1 through 99 pieces.



This year we are proud to list a complete new line of AC to DC power modules designated the "UN" Series. These hi-efficiency units operate from 400 Hz lines and have outputs from 5-50 VDC, including dual 12's and 15's. Output power ratings are 25, 50, and 100 watts at each voltage. All units are hermetically sealed and are built to meet specifications such as MIL-E-5400, MIL-STD-461. and MIL-STD-810.

For further information contact Abbott Transistor Laboratories, Inc., 5200 W. Jefferson Blvd., Los Angeles, CA 90016.

CIRCLE INQUIRY NO. 341

Home Computers: 2¹⁰ Questions and Answers About Hardware

So you bought a home computer. Now what? This book is for the person with a microcomputer who wants to get an idea of what it will — and can — be like to use it to the fullest. Ideas for things to do, help in reading the literature, help in deciding what ways to go — it's all here in easy-to-understand language for the beginner.

Table of Contents: Introduction — General concepts, It really isn't magic, Why is it happening now? What do I need to know to do what I want to do? Hardware — Number representations — binary, octal, hexadecimal, Logic, Circuit components, How to read diagrams, Putting components together, Some specific microprocessors, How to put a kit together. What You Can Do With It — Control, communications, computation, education, organization. Out-ro — Where to go from here. What's on the horizon.

150 pp. dilithium Press. 75 illus. February 1977. Paper \$6.95.

CIRCLE INQUIRY NO. 342

Home Computers: 2¹⁰ Questions and Answers About Software

A companion volume to the above book, this guide leads the new microcomputer owner through the thorny problems surrounding the selection and use of software.

Contents: How to program in — raw machine code, assembly language. Basic. What you can use arrays for. The best programming language. Structured programming.

150 pp. dilithium Press. 25 illus. March 1977. Paper \$6.95.

CIRCLE INQUIRY NO. 343

Microprocessor Books

Osborne & Associates dominate the market in microprocessor bodks. Our four available titles sell 10,000 to 15,000 copies per month. More than 500 universities have adopted these books

as texts. This acceptance reflects the high quality and extensive coverage provided.

"An Introduction to Microcomputers - Volume I - Basic Concepts" tells you everything you need to know about microprocessors and microcomputers in general. 285 pages, \$7.50, paperback.

"An Introduction to Microcomputers - Volume II - Some Real Products" covers every microprocessor on the market today and all their support devices. 868 pages, \$12.50, paperback.

"8080 Programming for Logic Design" and "6800 Programming for Logic Design" explain how to use microprocessors as a professional engineer in a digital logic environment. 280 pages, \$7.50, paperback.

For further information contact Osborne & Associates, Inc., P.O. Box 2036, 630 Bancroft Way, Berkeley, CA 94710; (415) 548-2805.

CIRCLE INQUIRY NO. 344

New Catalog Available Free

The new 96-page Heathkit Catalog describes nearly 400 electronic kits that will suit almost any interest. Available from Heath Company, Dept. 350-11, Benton Harbor, Michigan 49022, product categories include — Amateur Radio, Hi-Fi Components, Color TV, Test Instruments, Digital Clocks and Weather Instruments, Radio Control Equipment, Marine, Aircraft and Auto Accessories, and more.

New products introduced in the new catalog include a 3-way bookshelf speaker system, a battery monitor device for radio control modelers and a complete selection of fully-assembled, name brand 40-channel citizens band radios. Also noteworthy are Heath's convenient two-way freezer alarm and a mount-anywhere touch control light switch.

For further information contact Heath Company, Benton Harbor, Michigan 49022. (616) 982-3417.

CIRCLE INQUIRY NO. 345

Microprocessor Books

Four microprocessor paperback texts are available from Osborne & Associates. The four available titles sell between 10,000 to 15,000 copies per month. According to a company spokesman more than 500 universities have adopted these books as texts.

The four books are:

"An Introduction to Microcomputers — Volume I — Basic Concepts" tells you everything you need to know about microprocessors and microcomputers in general. It has 285 pages and costs \$7.50 in paperback.

"An Introduction to Microcomputers — Volume II — Some Real Products" covers every microprocessor on the market today and all their support devices. Volume II is 868 pages and runs for \$12.50 in paperback.

"8080 Programming for Logic Design" and "6800 Programming for Logic Design" explain how to use microprocessors as a professional engineer in a digital logic environment. Both books are 280 page paperbacks and cost \$7.50

For further information contact Osborne & Associates, Inc., at P.O. Box 2036, Berkeley, CA 94702 or at 630 Bancroft Way, Berkeley, CA 94710; (415) 548-2805.

CIRCLE INQUIRY NO. 346

ACM Publishes 1977 Administrative Directory

The 1977 edition of the Administrative Directory of Chairmen of University and College

Computer Science Departments and Directors of Computer Centers is now available from ACM Headquarters. In addition to names, addresses, and telephone numbers, the Directory lists computer science and data processing degrees offered and major on-site computing equipment. As in the past, the officers and key staff members of related computer organizations are included.

The Administrative Directory, consisting of more than 2,300 names, has nearly doubled in size from the first edition published last year and now includes colleges in Canada as well as the U.S. It may be ordered from the ACM Order Department, P.O. Box 12105, Church Street Station, New York, NY 10249 at \$7.00 for ACM members and \$9.00 for others, prepaid.

CIRCLE INQUIRY NO. 347

New Opto Component IEE Catalog

Industrial Electronic Engineers, Inc., (IEE), now has available a new Short Form Catalog (OCSF-1) featuring IEE's Opto Component Products.



Full product descriptions, specifications and illustrations contained in this convenient brochure include: IEE-APOLLO Incandescent Tube Digital Displays, IEE-AURORA Incandescent Flatplack Digital Displays, IEE-HERCULES Light Emitting Diode Digital Displays, IEE-ATLAS Universal Display Mounting Hardware, IEE-HERCULES/ELECTRA Solid State Indicators, and IEE-ELECTRA Subminiature Incandescent Lamps. All of the products described in the catalog are available through IEE's local stocking distributors.

IEE's Opto Component Short Form Catalogue is available free upon request to: IEE, 7740 Lemona Ave., Van Nuys, CA 91405; (213) 787-0311, ext. 268.

CIRCLE INQUIRY NO. 348

Your Introduction to Home Computers James Melsa and David Cohn

Beyond the Basics — You've read and learned about the fundamental skills. You are in touch with the possibilities and capabilities of your micro. You know who sells what and what each product can do. You know who else is working with micros in your area, and where the best computer store is. Now what?

Now you are ready for this more advanced book which will show you how to put together all you've learned, and apply it in new and exciting ways to your micro.

This is where your investment of time and interest will really begin to pay off. New and more advanced games; more complex and sophisticated applications; more challenging languages and concepts — all are here, explained in a lively and stimulating style.



COMPUTER COMPONENTS

5848 Sepulveda Blvd., Van Nuys, CA 91411 (213)-786-7411

Computer Components is dedicated to serving the needs of the computing community. We offer a complete line of computers and computer related products. We will ship anywhere in the world. Satisfaction guaranteed.

Hours:

Tuesday-Friday 10AM to 9PM Saturday, Sunday 10AM to 6PM

CLOSED MONDAY

Terms:

Call or write for discounts. We pay shipping on UPS orders over \$25. All others add \$2 for postage and handling.

We are authorized distributors for the following companies:

IMSAI • INTELLIGENT SYSTEMS • POLYMORPHIC SYSTEMS • CROMEMCO • TARBELL • KIM1 • TECHNICAL DESIGN LABS • SOLID STATE MUSIC • VECTOR GRAPHICS • RO-CHE SYSTEMS • CONTINENTAL SPECIALTIES • VECTOR ELECTRONICS • SAE • TEXAS INSTRUMENTS • SIGNETICS • NATIONAL SEMICONDUCTOR • ADVANCED MICRO DEVICES • SAMS BOOKS • HAYDEN • WILEY ... and more on the way. Always ask.

All the things you imagined yourself doing with your micro when you first got it — the hours of fun building new game plans, exploring new programming possibilities, devising new or more intriguing applications — all require more knowledge and skills than simple manuals can provide. This book builds on your basic knowledge and leads you on to a more sophisticated understanding of the powerful little tool your micro is.

You won't want to miss this chance to really master your micro. This book will introduce you to the full range of skills you need to get the most out of your challenging hobby.

175 pp. dilithium Press. 50 illus. March 1977. Paper \$7.95.

CIRCLE INQUIRY NO. 349

Low Profile Stripswitch Folder

Six pages fully describe the unique EECO 2500 series STRIPSWITCH. These minature, binary coded switches can be mounted directly on printed circuit boards with wave or hand soldering. They are low profile, ten position switches that feature a snap-together design and a choice of thumbwheel or scredriver settings. The folder shows dimensions, available codes, options, specifications, distributor sources and prices.

For further information contact EECO, 1441 E. Chestnut Ave., Santa Ana, CA 92701. Phone (714) 835-6000; TWX 910-595-1550; Telex 67-8420.

CIRCLE INQUIRY NO. 350

Buyer's Guide to Business Mini-computer Systems

A new, single volume buyers' guide to help the business user, analyst, or manufacturer compare, evaluate, and select currently marketed business minicomputer systems is now available from AUERBACH Publishers.

The Winter 1976-1977 issue of the AUER-BACH Buyers' Guide to Business Minicomputer Systems is now available for \$59 from AUER-BACH Publishers Inc., 6560 North Park Drive, Pennsauken, NJ 08109. It is also possible to purchase the Winter 1976-1977 and the Fall 1977 issues for a combined price of \$99.

CIRCLE INQUIRY NO. 351

Software

Realistic Controls Corporation Will Distribute Fortran Compiler for 8080

Cleveland, Ohio, November 1, 1976 — Realistic Controls Corporation (RCC), signed an agreement with Unified Technologies Inc. of Islington, Ontario appointing Realistic Controls Corporation as sole U.S. distributor of FORT/80, a resident FORTRAN IV compiler for the 8080 microcomputer.

FORT//80 is a high level language designed to simplify programming the industry standard 8080 microcomputer. It allows users to program their problems in FORTRAN directly on their inhouse development systems, drastically reducing software development, debugging and documentation costs.

RCC announced the immediate availability of FORT//80 for Intel MDS Systems using either paper tape or Intel or iCOM floppy disks (and their respective operating systems). In addition, FORT//80 will soon be available for Intel SBC systems with Intel or iCOM floppy disks.

FORT//80 is available immediately on a nondisclosure basis for \$750, plus a \$25 charge for media and documentation.

For further information contact Realistic Controls Corporation, 3530 Warrensville Center Road, Cleveland, OH 44122; (216) 751-3158.

CIRCLE INQUIRY NO. 352

Encounter!

Encounter! is the computer age version of game board warfare. This type of game characteristically contains a playing field upon which two opposing forces meet. The nature of the field varies from a single rectangular pattern to a world map. The forces may consist of men, markers, armies, units, bishops, and many more.

In Encounter! the forces are 'men,' all of equal worth, placed on a rectangular (10 x 12) grid of 'districts.' Some districts, described as blocked, may not be entered, and so create a distinct playing field. Each occupied district may be ordered to 'attack' an adjacent district held by the enemy. The battle then proceeds at a fixed pace without player intervention. The loss of men is determined by chance, heavily influenced by a sliding scale of odds — which depend on the relative sizes of the opposing forces.

Because it is a computer game, Encounter! has several new and exciting aspects which separate it from its predecessors. Most important is the fact that all of the activities in Encounter! occur in real time. There is no taking turns. Each player is attacking and defending in as many places on the field as he is mentally able to maintain at one time. Compared to the old-fashioned pre-computer days of taking turns, the pace is a furious one.

Also unique to this latest version of 'Game Board Warfare' is the game's ability to be reconfigured. The main game parameters, including the positions of the blocked districts (and so the playing field) can be easily changed. The newly created game can be stored as part of the overall game framework, to be recalled for playing at any time. As an example of this, Encounter! is actually delivered containing three different games: 'Maneuver,' 'Siege,' and 'Guerilla.'

Encounter! is written in BASIC 8080 assembly language and will run in 4K of RAM. (The origin is currently set at 16K.) A memory mapped video display with a 16 x 64 format (E.G. Processor Tech VDM-1) is required. Since the game involves two players working in real time, two independent keyboards are necessary. The software is provided as source code, with comments, game explanations, rules, etc. A paper tape is available at additional cost.

To order the Encounter! game, send a check or money order for \$12.95 to Objective Design, Inc., P.O. Box 20456, Tallahassee, Fla. 32304. Program available on paper tape for \$16.95. Florida residents please add 4% state sales tax. All orders shipped prepaid within U.S.

CIRCLE INQUIRY NO. 353

Software Package 0.5

This package is an addition to the well known Processor Technology Software Package No. 1 (SPKG1). SPKG1 is an assembler-editor combination with some elements of an operating system. It provides an 8080 computer with the ability to create a source program, maintain it in system RAM, and then assemble it. Although SPKG1 is a major improvement over switching in code directly to memory, it has some serious deficiencies. Perhaps it would be better to say that it is incomplete. Software package 0.5 (SPKG. 5) is intended to be added to SPKG1 and largely complete it.

All of the commands and options of SPKG1 are unaffected by SPKG.5. Memory requirements are increased by approximately 1.75K when all options of SPKG.5 are implemented. It is recommended that at least 12K of RAM be available for the editor/assembler combination.

SPKG. 5 is made available in the form of source code. The package is added to the user's existing SPKG1 system by editing in the source code and assembling the program. Therefore, an up and running version of SPKG1 is required to make use of SPKG. 5. Following assembly the user makes patches into the SPKG1 code, thus combining the two programs. Since SPKG. 5 is in source form, the user is free to configure his system according to the limitations of his hardware.

To order send check or money order to objective design, Inc., P.O. Box 20456, Tallahassee, FL 32304. Cost is \$14.95 plus 4% sales tax for Florida residents. Postage prepaid for all U.S. shipments.

CIRCLE INQUIRY NO. 354

New Business Software

Microbyte Computer Systems is now announcing a complete set of business software packages for the 8080 and Z80 processors. All program packages feature an extensive users' manual with technical documentation, two year software support with updates, and assembler level coding for efficient storage allocation and high processing speed. All software packages are designed for use by non-technical personnel.

Microbyte packages for accountants and businessmen include General Ledger, Accounts Receivable, Accounts Payable, Payroll Processing, Inventory Control and Accountants Quarterly Payroll System.

The Microbyte information retrieval system provides document selection and location based on presence/absence of selected key criteria, magnitude sensitivity of selected key values, and user weighted key criteria.

Microbyte software will be made available to run on all major microprocessors during the third quarter of 1977.

For further information contact Bob Barthelow, Microbyte Computer Systems, 584 Rio Lindo, Suite 4, Chico, CA 95926; (916) 891-1300

CIRCLE INQUIRY NO. 355

Spacewar Available For Cromemco Dazzler™

Probably one of the most famous of all computer games is now available for first time for a microcomputer. Spacewar is available for the Dazzler.

The Cromemco TV Dazzler is one of several peripherals in the hobbyist field. It lets the hobbyist see the content of this computer memory mapped in full color on an ordinary color TV set (Spacewar, however, is displayed in black and white).

With the new Cromemco software, two players play Spacewar using two Cromemco JS-1 joystick consoles.

Price for a paper tape listing of SPACEWAR is \$15. Tapes are available at computer stores or from Cromemco. Delivery from Cromemco is immediate.

For further information contact Joe McCrate, Cromemco, 2432 Charleston Road, Mountain View, CA 94043; (415) 964-7400.



Isn't it time . . . you had your own personal computer?

Read BUTE, the leading national publication covering the fantastic new field of personal computer applications. Today, large scale integration has made it possible for the individual to enjoy the unique benefits of a general purpose computing system. Now, an entire micro industry markets microcomputer related items, products that range from computer system kits to peripherals, software and literature on the subject. But where should you go for all the details about your personal involvement in computer technology?

Read BUTE, the Small Systems Journal devoted exclusively to microcomputer systems. Every issue a monthly compendium of lively articles by professionals, computer scientists, and serious amateurs.

- Detailed hardware and software design articles authored by individuals who are experimenting in the field.
- Tutorial background articles on hardware, software and applications ideas for the home computer and general topics of computer science.
- Reviews of processors as candidates for small general purpose systems.
- An editorial bias toward the fun of using and applying computers toward personally interesting problems such as electronic music, video games, control of systems for hobbies from ham radio to model railroading, uses of computers from burglar alarms to private information systems.
- Advertisements of the firms who bring you products to help expedite your personal computing activities.
- Information on clubs, newsletters and other social activities of the individuals engaged in personal computing.

Don't miss a single EVIE, Order your subscription today by filling in this coupon, or phone your request directly — call 603/924-7217 and ask for subscription department.

Read your first copy of BYTE from cover-to-cover. If it's everything you expected, honor our invoice. If it isn't, just write 'CANCEL' across the invoice and send it back. You won't be billed and the first issue is yours to keep.

Allow 4 to 6 weeks for processing

70 Main St., Peterborough, N.H. 03458 Please enter my subscription to BYTE... \$12 One Year \$22 Two Years Check Enclosed Bill Master Charge Credit Card Number Credit Card Expiration Date Name (Please Print) Address City State Zip

Games and Demonstrations Package for the KIM-1

These are contained in an integrated software package that includes a "language" which will let the user create his own programs. The software package, named PLEASE, runs on the basic KIM-It does not require additional memory, teletype, or special peripherals. PLEASE is distributed as a Cassette Tape, a sixteen page set of Operating Instructions, and a forty-four page set of annotated Source Listings and other PLEASE system information, including a Digital Clock, a High Speed Timer, an Adding Machine, and Intoxication Tester, a simple Guess-the-Number Game, a complex Number Game, the Shooting Stars Puzzle, a Moving Message Display, a Reaction Time Tester, a Decimal to Hex and Hex to Decimal Converter. Only \$10.00 from your favorite computer store.

For further information contact The COM-PUTERIST, P.O. Box 3, S. Chelmsford, MA 01824.

CIRCLE INQUIRY NO. 357

Unabridged Source Code & Documentation for 8080 Basic Published

January 30, 1977, Menlo Park, CA — The complete documentation, and a complete, annotated assembler listing of a BASIC interpreter for the 8080 has been published in *Dr. Dobb's Journal of Computer Calisthenics & Orthodontia*. The assembler listing, by itself, is over 46 pages long.

This particular BASIC interpreter was developed in 1976 by the Lawrence Livermore Laboratory. Those principally responsible for its development were John Dickenson, Jerry Barber, John Teeter, and Eugene Fisher. The Laboratory operates under the direction of the University of California and the U.S. Energy Research & Development Administration.

The BASIC interpreter is designed to operate on a MCS-8080 system. It is "pure code"; that is, it may be placed in ROM or PROM. It requires five kilobytes of storage for the interpreter. The interpreter includes a complete floating point package. The documentation and listing of the floating point routines is included in the materials published in *Dr. Dobb's Journal...*

For further information contact Dr. Dobb's Journal of Computer Calisthenics and Orthodontia, Box E, Menlo Park, CA 94025; (415) 323-3111.

CIRCLE INQUIRY NO. 358

OSI 6502 8K BASIC

OSI's new 8K BASIC for the 6052 was written by Microsoft, the people who wrote ALTAIR* 8K BASIC for the 8080. OSI's 6502 8K BASIC is identical to this powerful and popular 8K BASIC with two very important exceptions: our OSI 6502 8K BASIC has automatic string space handling, and it runs faster. Up to 8 times faster than the 8080 BASIC. And

hundreds of times faster than many 6800 BASICs.

In fact, the OSI Challenger with OSI 6502 8K BASIC can actually outperform most small and medium-scale minicomputers, as well as every micro there is! And that includes the Z-80.

Perhaps even more amazing than its superlative performance is its surprisingly low price: either \$50 or free.

OSI 6502 8K BASIC is available to OSI System kit builders for \$50, on your choice of paper tape, audio cassette or floppy disk.

And OSI 6502 8K BASIC comes free with the purchase of any 12K or larger OSI Challenger. For further information contact Ohio Scientific Instruments, 11679 Hayden St., Hiram, OH

CIRCLE INQUIRY NO. 359

44234.

Software Catalogue

TSC is pleased to announce the release of the world's first catalog dedicated to hobbyist computer software. It contains complete descriptions of over twenty programs for the 6800, six for 8080, and six for 6502. These programs include both games as well as many useful ones. All are written in assembly language, which means a high level language interpreter is not needed. Some of the titles are: HANGMAN, ACEY-DUCEY, SWITCH, HURKLE, SPACE VOYAGE™, KLINGON CAPTURE, MICRO BASIC PLUS, FLOATING POINT PACKAGE, DIAGNOSTIC PACKAGE, BATTLESHIP, and many more. The price of these programs range from \$1.50 to \$15.95, essentially the cost of documentation and handling Catalogs are \$.25 each and may be obtained from: Technical Systems Consultants, Box 2574, W. Lafayette, IN 47906.

CIRCLE INQUIRY NO. 360

BMS-700 Software Services

The BMS-700 Business Management System provides for applications as: On line Order Entry and Inventory, MRP — Bill of Materials, Billing and Receivables, Disbursing and Payables, General Ledger & Financial Statements, Payroll, Timesharing Administrative System, Simplified Data Base Management.

For further information contact Intelligent Systems Corporation, 460 Totten Pond Road, Waltham, MA 02154; (617) 890-9393.

CIRCLE INQUIRY NO. 361

Business Software Becomes Available

"Advanced Business," Volume III offers most computer owners the ability to automate daily business routines. The book is written in Basic and should execute in most 8K Basic computers with at least 15K memory. The book is divided into eight sections, each dealing with a particular program, and each program is listed in an easily readable format. ALL of the programs are self

prompting and require little or no programming knowledge to use or implement on a system.

This Volume is a must for anyone who has a business or is thinking of starting one. And best of all it sells for only \$39.95. That's less than five dollars for each program and where can you buy a payroll program that works for five dollars?

For further information contact Scientific Research, 1712-I Farmington Court, Crofton, MD 21114; (301) 721-1148.

CIRCLE INQUIRY NO. 362

Tiny Basic-X & Games

An ever-growing number of software packages designed for all levels of support is being offered by the Digital Group for the company's line of microprocessor systems.

For only \$5 each, the Digital Group offers Tiny Basic Extended and a cassette full of game programs. Both are on audio cassette that the Digital Group system can read. Programs can be displayed on the system's video screen.

The Digital Group also offers many other software programs. For example: six volumes of Tiny Basic Games, including Chomp, Checkers, 20-Questions, Chief and others; "Galaxy," and Z-80 packages including Educator, Assembler, Dis-Assembler and Text-Editor. Prices range from \$5 to \$15.

Details on all Digital Group products — hardware and software — are available by calling or writing the Digital Group, P.O. Box 6528, Denver, CO 80206, Telephone (303) 777-7133.

CIRCLE INQUIRY NO. 363

Classes in BASIC and 8080 Assembler

Computer Power & Light offers a series of regularly scheduled classes in BASIC and in 8080 assembler programming at its educational facility in Studio City, California. These small, colloquium-style classes feature significant "hands on" experience using the five systems always available to students. By using a large screen demonstration computer and overhead transparencies-maker, the instructor can demonstate and discuss new material and students' programs with maximum effectiveness.

The BASIC class, which meets either two evenings each week for four weeks or once a week for eight weeks, covers all the elements of writing, documenting, de-bugging and using applications programs

The Assembly Language class meets on Saturday mornings for eight weeks, and emphasizes programming skills and the construction of flexible, standard, well-documented machine language routines.

Fee of \$100. includes all texts, materials and computer time.

For further information contact Computer Power & Light, 12321 Ventura Blvd., Studio City, CA 91604; (213) 760-0405.

CIRCLE INQUIRY NO. 364

Miscellaneous

Zero Insertion Force MOS/LSI Socket

The 2944 series sockets feature self ejection of the LSI module, positive lock in the loaded LSI position and zero axial insertion force during the loading cycle. The 2944 series now includes a 24, 28, 36 and 40 position sockets.

Since LSI leads are delicate and easily bent, a zero axial force socket helps eliminate the danger of bending and breakage during the insertion cycle. Many LSI's packages can be fractured during insertion when force is applied to the LSI

package. A zero insertion force socket helps minimize the risk of package breakage.

Defective LSI's cannot normally be returned to the vendor if leads are broken or soldered. The Molex zero insertion force socket allows for repeated insertions and withdrawals of the LSI module.

Pricing on this product ranges from 40 cents to 65 cents depending on the socket size and quantities. A two page specification sheet is available from molex Incorporated.

For further information contact Allen Maag, (312) 969-4550; Molex Incorporated, 2222 Wellington Court, Lisle, IL 60532.

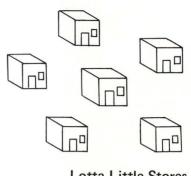
CIRCLE INQUIRY NO. 365

Programmable Calculators

Hewlett-Packard Co. — New HP-67 and HP-97 fully programmable calculators have more than three times as much program memory capacity as the pioneering HP-65. The HP-97 is a battery powered, portable calculator with a built-in thermal printer while the HP-67 is a pocket sized version. Calculators feature 26 data storage registers, fully merged keycodes, "smart" card readers, eight conditional tests, user-definable keys, three types of addressing schemes and automatic review of storage register contents. Programs may be entered into the

WE'VE GOT IT ALL TOGETHER





Lotta Little Stores THEM

People ask us when we're going to open more stores. That would be a logical result of our success. We've expanded, but all in one location, in Santa Monica. This means we have more people, more demonstration equipment, more inventory, and more spare parts. We've concentrated our resources. For the very best information and service, ask us, we're

THE MOST EXPERIENCED COMPUTER DEALERS ANYWHERE

THE COMPUTER STORE

820 Broadway Santa Monica, Calif. 90401 Phone (213) 451-0713

Store hours: Tues-Fri: Noon — 8 pm

Saturday: 10 am - 6 pm

Located 2 blocks North of the Santa Monica Freeway at the Lincoln Blvd. exit



Authorized dealer for MITS, Cromemco, North Star, Peripheral Vision, TDL, Microterm, SWTPC, Polymorphic, Multiterm, Oliver, and Sanyo. BankAmericard and Mastercharge welcome.

calculators either from the keyboards directly, or from small, prerecorded magnetic cards.

For further information contact Jerry D. Fisher, Hewlett-Packard Co., 1000 N.E. Circle Blvd., Corvallis, OR 97330; (503) 757-2000, ext. 2268.

CIRCLE INQUIRY NO. 366

New LED Display Decoder/Driver

Industrial Electronic Engineers, Inc. (IEE), has announced the new IEE-ATLAS LED Display Decoder/Driver designated as Series 1760-0X.

The Series 1760 is designed to be integrally mounted onto the back of IEE-ATLAS Display Mounting Hardware Series 1750/1751/1752-OX (wire-wrap terminal models). These decoder/drivers will accept either four line BCD or serial, pluse count inputs; all models incorporate an inherent memory capability. Model 1760-01, -03 is the decoder/driver with memory, while Model 1760-02, -04 has memory and counter.



When mounted, the decoder/driver additionally extends behind the main body of the mounting hardware — measured from the back face of the socket as follows: Model 1760-01, -03 — 1.75" (44.5mm); Model 1760-02, -04 — 2.18" (55.4mm). Series 1760-0X can be used with standard PC connector or directly solder terminated. In 500-piece quantities, 1760-01, 03 is \$7.35 each and 1760-02, 04 is \$9.60 each. Delivery is off-the-shelf.

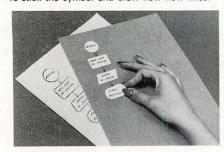
An extensive 8-page Product Profile featuring dimensional drawings, pin assignments, electrical characteristics and detailed ordering information is available free upon request to IEE, 7740 Lemona Ave., Van Nuys, CA 91405, (213) 787-0311, ext. 268, attention: Bob Brandt, product sales manager.

CIRCLE INQUIRY NO. 367

Stick On and Peel Off Symbols

A base-board and complete line of programming symbols provide the needed tools to create a program flow chart quickly, efficiently and neatly. No more messy, time consuming, thought destroying erasures. Fickled Thinking Aids let your charting flow as fast as your ideas.

The symbols are a special material. The baseboard is the working surface. Write on them with a common ball point pen. If you need a change, simply peel off the symbol, rub out the flow lines, re-stick the symbol and draw new flow lines.



You may peel off, rub out and re-stick as many times as you want.

Symbols are A.S.A. X3.5 (¾ size): input/output, process/annotation, punched card, magnetic tape, punched tape, online storage, offline storage, connector, document, display, manual input, decision, drum, terminal, communication link, manual operation, auxiliary operation and preparation.

Base-board sizes are: 8½" X 14" (legal size), 11" X 17" (B size), 17" X 22" (C size), 22" x 34" (D size) and specials for classroom or group display.

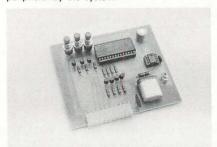
The "Starter Kit" includes 10 legal size base boards and over 320 symbols. It sells for \$8.95 plus \$1.00 postage and handling.

For further information contact Fickled Thinking Aids, P.O. Box 6064, 990-m Enterprise Street., Orange, CA 92667. Telephone (714) 639-9061.

CIRCLE INQUIRY NO. 368

Real Time Clock

The Hardware real time clock allows your computer to keep track of the time of day for control, timer and game applications. The clock keeps track of the time itself and is treated as a peripheral by the system.



Latest CMOS technology results in high reliability, small size and low power consumption. Simple connection to your system — TTL compatible inputs and outputs, 4 wires to a parallel input port, 3 wires from a parallel output port, ground, +5 volts and +12 volts. May be used with any computer system. Complete documentation on hardware & software. Crystal controlled accuracy with a trimmer to allow exact frequency setting. Push buttons allow easy time setting. The clock can be operated off a separate power supply or battery allowing it to keep the correct time even when the rest of your computer system is off.

SPECIAL INTRODUCTORY PRICE: \$39.95 wired and tested including manual and connector. IC sockets used on all IC's, board is G-10 material. Unit is available only in wired form. Check or money order only. Wisconsin residents add 4% sales tax. Add \$0.75 for postage for each unit ordered.

For further information contact TED, P.O. Box 4122, Madison, WI 53711.

CIRCLE INQUIRY NO. 369

Useful Products for the Designer

Several distinctly different types of product lines offered by Circuit-Stik include its patented line of pressure sensitive circuit subelements and its GP "plug-in" circuit boards. Also, we produce a high quality line of drilled epoxy glass board materials in .100 grid, (both clad and unclad), "X-Y" conductor boards, and also our newly developed "Cut & Peel" material. Packaging interconnections include copper tape, stripline, feedthrough terminals, wire wrap pins, and socket pins. Our "plug-in" hardware includes wire wrap sockets, low-profile sockets, a new line of economy low-profile sockets, and connectors for circuit boards, including solder tail and wire wrap.

As there are several distinct categories of products, each has been developed to better satisfy a customer's prototyping problems in certain design areas and to extend the usefulness of his prototype board further than is normally expected from a breadboard.

For further information contact CIRCUIT-STIK™ Inc., 24015 Garnier Street, Torrance, CA 90505; (213) 530-5530.

CIRCLE INQUIRY NO. 370

AP Headers

AP Headers are non-shrouded molded strips of contacts. They are available in both male and female, straight and right angle, gold-plate and solder-plate, single-row and double-row, single-spaced and multiple-spaced rows, and in several contact pin lengths.



The dielectric spacers used can withstand mass soldering operations and strong solvents and they are ultrasonically weldable to produce matrix configurations.

Pin spacing on both male and female Headers is the industry standard .100". AP Header strips are designed so that when stacked, a .100" by .100" is established. Alternately, spacer strips are available to establish a matrix of .100" by any integral multiple of .100". Both .100" x .100" and .100" x .200" matrix Headers are stock items in the AP Header line.

The standard .100" spacing makes AP

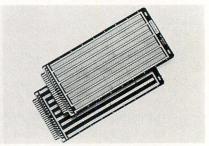
The standard .100" spacing makes AP Headers a natural for interfacing with AP Great Jumpers" and other flat ribbon cable/connector systems.

For further information contact AP Products Incorporated, Box 110, 72 Corwin Drive, Painesville, Ohio 44077. (216) 354-2101.

CIRCLE INQUIRY NO. 371

Circuit-Stik G.P. Boards

Designed for use in micro-processor memory and interface assembly breadboarding, ideal for general digital, analog circuits and micro-computer expansion. G.P. Board Features: *Pre-drilled* holes (Not punched), pre-routed contours, RFI shielding on component side, mounting and innerconnections, versatility, gold-nickel edge contacts; card-cage compatibility.



For further information contact Circuit-Stik Inc., 23535 Telo Avenue, Torrance, CA 90505; (213) 530-5530, TLX 69-8223.

CIRCLE INQUIRY NO. 372

HP-45 Crystal Conversion Kit

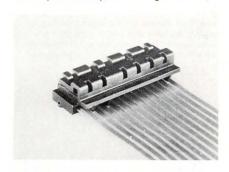
For those HP-45 owners who would like to use the 10-way stopwatch function of their calculators. This makes the times accurate and simplifies its use. The cost of the conversion kit is \$13, which includes instructions, all necessary components, and shipping.

For further information contact EGBERT ELECTRONICS, 1514 S. 320 E., Orem, UT

Molex 4850 Flat Conductor Connector

The new Molex 4850 flat conductor connector design features include:

- · designed for cable or flexible etched circuits
- · zero insertion/extraction force
- numerous insertion and withdrawals without damage to plating or flat conductors
- connector locks to printed circuit board for soldering and use
- · eliminates soldering to flat conductor cables or circuitry
 - · simple assembly, no learning curve



The focal point of the connector is a two-piece design with a snap-on hinge cam, which allows numerous insertions and withdrawals (200 minimum) without damaging expensive and fragile etched circuits. The housing is molded of glass filled, 94V-O, U.L. rated, polyester. Built for .100 centers, the connector also features built in strain relief and novel locks for connector retention to the printed circuit board during soldering and operation. The 4850 is available in 5 through 25 circuit sizes, inclusive. Printed circuit board solder tail terminals are pre-tin plated. Gold plating is available.

For further information contact Molex Incorporated, 2222 Wellington Court, Lisle, IL 60532.

CIRCLE INQUIRY NO. 374

Computer Music Equally Tempered D/A Converter Kit

Unlike more conventional R-2R ladder type digital to analog converters, the PAIA 8780 kit is based on a multiplying principle that allows the module to generate the exact exponential stairstep function required to make even the simplest linear response oscillators and filters produce equally tempered musical intervals.



The 8780 uses only six bits of data to generate over 5 octaves of control voltage. In an 8 bit system, the remaining 2 bits are ordinarily reserved for trigger flags, but may be used to extend the range of the converter or provide microtonal tunings

The module is physically and electrically compatible with the complete line of PAIA music synthesizer modules and is easily interfaced to any microprocessor with or without handshaking logic.

Mail order price of the module kit is \$34.95 plus \$1.00 postage and handling.

For further information contact PAIA Electronics, Inc., 1020 W. Wilshire Blvd., Oklahoma City, OK 73116. Free catalog available on request

CIRCLE INQUIRY NO. 375

Same day shipment. First line parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

INTEGRATED CIRCUITS

	u .	711						CD4044	2.00	8109 1.25				
7400TTL		74LS05	.34	LM339N	1,55	IN4733A	.25	CD4049 CD4050	.62	8T10 4.50 8T20 5.50				
7400N	.17	74LS08N	.28	LM340K-5	1.60	IN4734A	.25	CD4066	.85	8T23 3.10		AFI E	CTRONIC	20
7402N 7404N	.17	74LS10N 74LS20N	.28		1.50	IN4736A IN4738A	.25	CD4068 CD4069	.25	8T24 3.50 8T25 3.20	The state of the s	LLL	CIRCINIC	,,
7405N	.22	74LS28N	.41	LM340T-12	1.70	IN4739A	.25	CD4009	.40	8T25 3.20 8T26 2.75		12.00	RESISTORS	
7410N	.17	74LS30N	.28	LM340T-15	1.70	IN4742A	.25	CD4072	.40	8T28 2.75			1/4 watt 5%	.05
7414N 7420N	.63	74LS38N 74LS74N	.39	LM358N LM377	2.40	IN4744A	.25	CD4073	.40	8T97 2.45			10 per type 25 per type	.03
7430N	.20	74LS75N	.65		4.50 5.00	IN4746A IN4749A	.25	CD4075 CD4076	1.75	8T98 2.45	Keyer 8043 14.50	LEDS	100 per type	.025
7438N	.25	74LS90N	1.10	LM380N	1.00	IN4751A	.25	CD4078	.40	MOS/MEMORY RAM 2101-1 4.50	IC Test Clips 1 10		15 1000 per type	.02
7440N 7442N	.17	74LS93N	1.10	LM703H	.40	IN4752A	.25	CD4081	.40	2102-1 1.80	Red .50 .43		20 CRYSTALS	
7442N	.78	74LS95N 74LS107N	.1.89	LM709H LM723N	.28	IN4764A 2N3904	.25	CD4082 CD4508	4.25	21078 8.00	Black .50 .43	Yellow T018	20 1 MHz 4.50 20 2 MHz 4.50	6.5536 MHz 4.50 1.8432 MHz 4.50
7448N	.78	74LS112N	.52	LM733N	.89	2N3906	25	CD4510	2.00	2111-1 7.00	CLOCK MODULES	Jumbo Red	20 4 MHz 4.25	2.097152 MHz 7.75
7450N	.17		1.15	LM741CH	.35	A to D CONVE		CD4511	2.20	2112-2 7.90 2513B 10.00	Complete clock module minus transformer and switches.		25 5 MHz 4.25	2.4576 MHz 7.50
7473N 7474N	.36	74LS155N 74LS163N	1.50	LM741N LM1303N	.25	8700CN 16	5.00	CD4515 CD4520	4.00	21L02-1 2.50	MA1002A, C. E .50" \$8.95	Jumbo Yellow Jumbo Orange	25 10 MHz 4.25 25 18 MHz 3.90	3.2768 MHz 7.50 5.0688 MHz 4.50
7475N	.49	74LS174N	1.85		.82		3.75	CD4520	4.75	MM5058 2.20	102P3 Transformer 2.25		on 20 MHz 3.90	5.185 MHz 4.50
7483N	.70	74LS258N	2.20	LM2902	1.50	CMOS CD34001 Fair.		CD4528	1.50	MM5060 3.20 MM5262 90	MA1010E .80" 11.95 102P2 Transformer 3.25	Cliplite LED mounting	32 MHz 3.90	5,7143 MHz 4,50
7485N 7489N	2.00	74S00 TTL		LM3900N LM3909N	.55	CD4001 Fair.	.50	CD4583	4.50	MM5320 5.95	MA1013E .70" 10.95	Clips 4/1.1	00 32/08 HZ 4.00	18.432 MHz 4.50 22.1184 MHz 4.50
7490N	.45	74S00 74S02	.29	MC1458V	.89	CD4002	.25	CD4585 CD40192	2.10	MM5330 9.75	102P4 Transformer 3.25	(specify red, ambegreen, yellow, clean		22.1104 MHZ 4.50
7492N	.45	74504	.30	NE540L	3.90	CD4006 CD4007	1.35	74C00	.28	CLOCKS	4 digit, 7 function stop-	Switches	MAN1	CA .270 2.90
7493N 74100N	.49	74510	.90	NE550N	.65	CD4007 CD4008 1	.25	74C04 74C10	.33	MM5309 3.90 MM5311 3.60	watch/timer circuit.	Mom. Pushbutton		CC .125 .39
74107N	.39	74874	.68	NE555V NE556A	1.00	CD4010	.53 .25	74C14	2.10	MM5312 4.80	new National MM5865 \$9.00. PC board \$7.50.	On off on toggle 1.3		CC .500 3.50 CA .300 1.50
74121N	.39	LINEAR CA3082	1.90	NE565A	1.00	CD4011 CD4012	.25	74C20	.28	MM5313 3:60	DM8863 \$1.75. 10 page	On none on toggle 1.1 Encoder	MAN74	CC .300 1.50
74123N 74125N	.87	CA3089	3.60	NES66V	1.85	CD4012	.25	74C30	-,28	MM5314 3.90 MM5315 4.00	spec only, \$1.00.	HD0165-5 7.5	50 DL704	CC .300 1.25
74132N	1.25	LM301AN	.35	NE567V 78L05	1.25	CD4014 1	1.25	74C48 74C74	2.95	MM5316 5.00	IC SOCKETS	3 Digit Universal Counter Board Kit	DL707 DL727	CA .300 1.50 CA .500 2.55
74145N	.89	LM301AH	.35	78L08	.90	CD4015 1 CD4016	.25	74C106	2.10	MM5318 8.95	Solder Tin Low Profile PIN 1 UP PIN 1UP	Operates 5-18 Volt E		CA .600 2.35
74150N 74151N	.95	LM307N LM308N	.35	79L05	1.00		.50	74C160	2.00	MM5369 2.10 MM5371N 5.50	8 .15 24 .36	to 5 MHz typ125"LE	D FND359	CC .357 .95
74151N 74154N	1.10	LM309K	.95	75451CN 75452CN	.39	CD4020 1	.35	74C192 74C221	2.40	MM5841 10.80	14 .18 28 .43	display 10.5	50 FND503 FND510	CC .500 1.20 CA .500 1.20
74157N	.95	LM311H	.90	75491CN	.50	CD4021 1	.20	740905	3.00	CT7001 5.80	16 .20 36 .58	UART/FIFO	ENDROO	CA .500 1.20 CC .800 1.90
	1.19	LM318 LM320K-5	1.35	75492CN	.55	CD4023 CD4024	.25	74C906	1.50	MM5375AA/N 3.90 MM5375AB/N 4.90	18 .27 40 .61 22 .35	AY5-1013 6.2 3341 8.5	FND807	CA .800 1.90
74175N 74193N	.90	LM323K-5	6.95	75494CN	.89	CD4025	.25	74C925 74C926	10.50	7205 16.50	MICROPROCESSOR	PROM		lay 2.50
74285N	6.00	LM302K-12	1.35	DISCRETES IN4001	.08	CD4026 3	.85	740926	12.00	MM53104 3.00	8080 with data 19.00	1702A 11.5	NSN33M 3 digit 8 7520 Clairex photo	pin .39 cells .25
74298N	1.65	LM320K-15 LM320T-5	1.35	IN4002	.08	CD4027 CD4029 1	.55	INTERFAC		DS0026CN 3.75 DS0056CN 3.75	8080A with data 23.50	N82S23 3.2	5 5082-7340 Hex	6.75
74LS00 TT		LM320T-8		IN4003	.08		.42	8095	.75	DS0056CN 3.75 MM53104 3.75	8212 4.50	N82S123 4.0		
74LS00N 74LS02N	.28	LM320T-12	1.60	IN4004 IN4005	.08	CD4040 1	.35	8096	.75	MISCELLANEOUS	8224 8.50 8228 8.50	N82S126 4.8 82S129 4.8		s Chip \$19.95 river 3.75
74LS04N	.20	LM320T-15 LM324N		IN4005	.08		.50	8097 8098	.75 .75	12 Volt 300 ma	CDP1802CD 29.50	2708 36.0	0 LM1889 Modulator	r 3.00
		LM024N	1.10		.40	UU4U43 2	.00	0000	.73	transformer 1 25	CDP1802D 35.00	DM8577 2.0	O CLAVSDEOD 1	24.50

VOLUME SPECIALS

		1	
MM5262	2K RAM	.90	
MM5369	Divider	2.10	- 1
2102-1	500 NS 1K RAM	1.80	- 1
FND503	.50" Display	1.00	
18MHz	Crystal	3.90	2
PD411-3	150 NS 4K RAM	8.00	5
MA1002E	5" Alarm Clock Mod.	8.95	7
MA1013E	.7" Alarm Clock Mod	10.95	8
MM5309	Clock	3.90	2
MM5314	Clock	3.90	2
Momentary	Pushbutton Switch	.50	
	Other parts also avail.		

1977 IC Undate Master Manual

Brand new. Complete IC data selector from all manufacturers. 17,000 cross references. \$30 with update service thru 1977. Domestic postage add \$2.00, Foreign \$6.00.

Car Clock Kit \$28.50

.4" LED's, crystal time base, beautiful dark gray case. Com-plete with mounting bracket and full instructions and full instructions.

Stopwatch Kit \$26.95 all six digits. Times std., split ad Taylor 7205 chip, all comp. inus case with full instruct.

Not a Cheap Clock Kit \$17.45

Includes everything except case. 2-PC boards. 6-.50" LED Displays. 5314 clock chip, transformer, all components and full instructions.

Same clock kit with .80 displays \$22.75

60 Hz Crystal Time Base Kit \$4.75

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy. Kit includes: PC board, MM5369, crystal, resistors, capacitors and trimmer.

Frequency Counter Kit

Covers audio, ultrasonic and low amateur hand 10 Hz to 2.5 MHz typ. Dual channel high sensitivity ±25 millivolts. Crystal controlled clock. Can be prescaled for higher frequency. 6-,50" digits. Full instructions \$40.00 Less power supply.

Digital Temperature Meter Kit

P.O. Box 4430N Santa Clara, CA 95054

(408) 988-1640

Indoor and outdoor. Automatically switches back and forth. Beautiful. 50" LED readouts. Nothing like it available. Needs no additional parts for complete, full operation. Will measure -100° to +200°F, air or liquid. Very accurate. Compl. instruct. \$39.95

COSMAC 'ELF

RCA CMOS Microcomputer
COPHROZCO 529:50 Users Manual 7:50
Complete kit of parts to build
the "ELF" including CDP1802
and users manual as listed August 7:6 Pop. Elect. minus
power supply and board. \$92

FREE: Send for your copy of our 1977 QUEST CATALOG. Include 13¢ stamp. TERMS: \$5.00 min. order U.S. Funds. Calif residents add 6% tax.

CIRCLE INQUIRY NO. 62

New Thin .315" Thumbwheel Switch

BankAmericard and Master Charge accepted.

EECO 1800 series Thumbwheel switches feature extra slim 8mm (.315) wide switch modules and switch assemblies that can be snapped unto panels without tools or screw "Across-the-room" legibility is available holes. with .234" high characters.



1800 series switches are available in a number of 10 position codes including BCD, BCD with complement, BCD complement only, decimal and repeatings. Options include direct wire or connector termination, gloss or matte finish, decimal points, custom dial marking, stops and diode provision.

Contacts are gold plated, the housing is self extinguishing nylon and the circuit board is flame resistant glass epoxy. Operating temperature -20°C to +65°C. Initial contact range is resistance is 0.1 ohm maximum.

Prices start at \$2.00 in 1000 piece quantities with 6-week delivery for prototype units.

For further information contact EECO, 1441 E. Chestnut Ave., Santa Ana, CA 92701; Phone "Switch Products" (714) 835-6000.

CIRCLE INQUIRY NO. 376

Lightweight Wrapped-Wire Tool Reduces Operator Fatigue

A new lightweight 110 V.a.c. 60 hz. wrappedwire tool, designated the P160-4T1 by Vector Electronic Company cuts wiring time, eliminates wire stripping, and reduces operator fatigue while allowing continuous wrapping during long production or prototype wiring runs. Weighing only seven ounces, the pistol-gripped tool is considerably lighter than tools commonly used and the \$80.00 price is up to fifty-percent lower than competitive power tools.



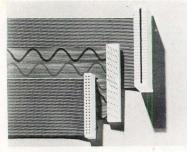
The 6.7-inch-long tool accepts either a P180 Slit-N-Wrap bit or a P160-2A wrapping bit. The P180 permits daisy-chain wrapping on 0.025 inch square posts without cutting or stripping the wire. Supplied from a spool, the 28-AWG wire passes over a fine knife edge which slits the insulation as it is wrapped around the post. The technique reduces wiring time up to 80 percent. The P160-2A bit is used with conventional 26-AWG to 30-AWG wrapping wire on 0.025 inch and 0.028 inch square posts.

For further information contact Vector Electronic Co., Inc., 12460 Gladstone Ave., Sylmar, CA 91342; (213) 365-9661.

CIRCLE INQUIRY NO. 377

Great Jumpers™

Great Jumpers™ are fully pre-assembled and fully pre-tested flat ribbon cable/connector assemblies. They are available in several line widths, a choice of conductors, and a selection of opposite end terminations.



Particular to the Great Jumper family is an especially useful doubly-encoded Rainbow cable, color-coded line-by-line on the front, and colorstriped in groups of ten on the reverse

The standard cable color in the Great Jumpers family is a distinctive Electric Pink.

Double-ended and daisy-chained (Great Daisy Jumpers) configurations can include not only PCB connectors, but standard double-row .100". center socket connectors and card-edge connectors as well.

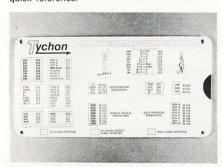
They are molded on during factory assembly and include integral strain relief and line-by-line probability.

For further information contact AP Products Inc., Box 110, 72 Corwin Drive, Painesville, OH 44077; (216) 354-2101.

CIRCLE INQUIRY NO. 378

TYCHON'S 8080 Octal Code Card

Tychon Incorporated is pleased to announce its 8080 Octal Code Card. The code card is a slide rule-like aid for programming and debugging 8080 software. It contains all the mnemonics and their corresponding octal codes. The instructions are all color coded to indicate which flags are affected during execution. The pocket sized card measures 6.5 by 3 inches and it provides the instructions in a neat, logical format for quick reference.



The back side of the card is printed with an ASCII code chart for all 128 characters plus the 8080 status word and register pair codes.

Delivery of the 8080 Octal Code Card is immediate and the price is \$2.95 postpaid. Quantity discounts start at ten units and custom imprinting is also available. A hexadecimal card will be available within 60 days.

For further information contact C. A. Titus at Tychon, Inc., P.O. Box 242, Blacksburg, VA 24060; (703) 951-9030.

CIRCLE INQUIRY NO. 379

IMC Introduces μP Compatible DPM's

Designed to be totally compatible in microprocessor and instrumentation applications, IMC's new Series 600 41/2 digit Digital Panel Meter offers a variety of features: multiplexed BCD output; true ratiometic operation; run/hold command input; strobe and busy output; adjustable external sample rate; display blank and lamp test inputs; and ±12Vdc @ 5mA output.



Options include blank board that allows customer to add special circuits within the DPM package and a choice of 120/240Vac, 50/60Hz power input or a tristate parallel BCD buffer.

Ranges are: 199.99mVdc; 1.9999Vdc; 19.999Vdc; 199.99Vdc with single ended bipolar input. Impedance is 1000 megohms for the 200mV and 2V ranges and 10 megohms for all others. Zero is automatic and the display is 4½ digit, red L.E.D.'s .43" high with decimal point externally selectable.

Accuracy of the Series 600 is ±0.008% ±1 digit, full scale. Power input is 5Vdc, ±5%, 400mA. The versatile instrument is housed in IMC's standard molded Cycolac package which measures 3¾" wide x 2½" high x 2¾" deep.
Price of the Series 600 is \$145 in unit quan-

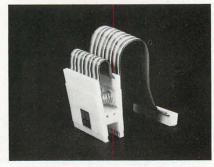
tities and delivery is stock to four weeks.

For further information contact Dr. Otto Fest, International Microtronics Corporation, 4016 E. Tennessee St., Tucson, AZ 85714; (602) 748-7900.

CIRCLE INQUIRY NO. 380

The Logical Connection

The Logical Connection comes fully preassembled and fully pre-tested with molded-on connectors that feature integral strain relief and line-by-line probability.



What is unique about The Logical Connection is that it is designed to mate directly with the contact posts of A P's IC Test Clips.

The Logical Connection translates the pins atop A P's IC Test Clip into a standard double row flat cable socket connector through any desired length of Great Jumpers ribbon cable.

The Logical Connection has already met wide acceptance from the people who are manufacturing logic analyzers and related equipment. Almost all are using The Logical Connection

For further information contact AP Products Inc., Box 110, 72 Corwin Drive, Painesville, OH 44077; (216) 354-2101.

CIRCLE INCUIRY NO. 381

Programmable Drum Set

While most electronic rhythm units offer only a limited choice of pre-determined rhythm patterns, the PAIA Programmable Drum Set allows the user to tailor pattern, time signature and drum sounds to each application. Among the unique features provided by the unit are touch sensitive electronic controls and the provision for an independently structured bridge rhythm.



Battery powered, the drum set includes a "memory save" switch which provides a lowered "keep-alive" voltage to the drum set's 256 byte memory.

The PAIA 3750 Programmable Drum Set is available in kit form for \$79.95 plus \$3.00 postage and insurance from: PAIA Electronics, Inc., 1020 W. Wilshire Blvd., Oklahoma City, OK 73116. Free catalog available on request.

CIRCLE INQUIRY NO. 382

Model 55 Microprocessing **GPIB** Interface

The Model 55 Microprocessing GPIB enables the Dana Series 5000 and 5900 Digital Multimeters or the Series 6900 Precision Voltmeters to be interfaced with other instrumentation and control devices utilizing the "standard interface bus" structure.



The Model 55 Microprocessing GPIB is completely self-contained in a 134 inch high, rack mountable, piggyback package. It is compliant with IEEE Std. 488-1975, "IEEE Standard Digital Interface for Programmable Instrumentation." All connectors and cabling to connect the Model 55 with the 5000, 5900, or 6900 are provided as well as the standard connector to connect with the "bus." Price \$825.00.

For further information contact Dana Laboratories, Inc., 2401 Campus Drive, Irvine, CA 92715; (714) 833-1234, Teletype 910-595-1136, Telex 678-341

synchro-sound enterprises "THE COMPUTER PEOPLE"

NEW FULLY ADDRESSABLE CURSOR



LEAR-SIEGLER MODEL ADM-3A

CHARACTER GENERATION

5 x 7 dot matrix.

DISPLAY FORMAT

Standard: 1920 characters, displayed in 24 lines of 80 characters per line.

CHARACTER SET

Standard: 64 ASCII characters, displayed as upper case, plus punctuation and control.

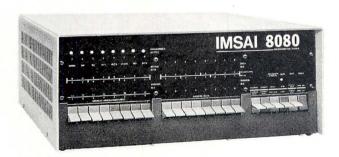
COMMUNICATION RATES

75, 110, 150, 300, 600, 1200, 1800, 2400, 4800, 9600, 19,200 baud (switch selectable).

COMPUTER INTERFACES

EIA standard RS232C and 20 mA current-loop (switch selectable).

ALL ITEMS IN STOCK



IMSAI 8080 MICROCOMPUTER
POWERFUL • EASY TO USE • LOW COST
IMSAI 8080
619.95 /22 SLOT BOARD



OKI DATA PRINTER

OKIDATA MODEL 110
110 CPS DOT MATRIX LINE PRINTER
FRICTION FEED 1099.00
TRACTOR FEED 1229.00
RS 232 C SERIAL INTERFACE 250.00

LEAR SIEGLER ADM-3A

LOWER CASE

KIT WIRED 895.00 1099.00 89.00

FOLLOWING ITEMS IN STOCK: TDL, OAE, PROCESSOR TECH, SWTP, HAYDEN, TARBELL, LEAR SEIGLER, OKIDATA, IMSAI, JAVELIN





193-25 JAMAICA AVE JAMAICA, N.Y. 11423 HOURS: 9-4 TUES — SAT VISIT OUR NEW SHOWROOM (212) 468-7067



Book Review

THE COMPLEAT COMPUTER, Dennie L. VanTassel, Science Research Press, 216 pages. \$5.95 Paperback.

THE COMPLEAT COMPU-TER is an absolute must in the library of anyone interested in computer history and folklore. It is, as the cover states, "a compendium of tales of the amazing and marvelous, poetry, informative news items, articles for edification and enjoyment, cartoons, plus many other illustrations." In addition, the book contains a special section of science fiction art in magnificent color.

VanTassel has gathered a remarkable collection of articles and short stories ranging from the sublime to the ridiculous. In addition, each chapter contains a brief bibliography (Branch Points) and a collection of "thought questions," e.g., "Predict what computers will be used for in the year 2000," called Interrupts. These Interrupts can provide many hours of mental exercise or could be casually brought up at a party or dinner table to promote stimulating conversation.

THE COMPLEAT COMPU-TER is just plain fun - both for the computer expert and for the naive reader. With editorials by Buchwald, science fiction by Asimov, Bradbury and Clarke, and numerous other computerrelated items, this book is sure to contain something of interest to any reader. There are even eight Doonesbury computer cartoons ranging back to 1970 which may well wind up on your ter-

minal, bulletin board, desk or refrigerator. There are articles on computer dating services, Watergate, computer crime and crime prevention, man versus

machine and vice versa.

Randomly opening to any page results in an eye catching drawing, an amusing anecdote or a full article to engross the reader's interest. For the science fiction enthusiast there is an entire section on science fiction art featuring full-color reproductions of ANALOG and ASTOUNDING SCIENCE FICTION magazine covers going back as far as 1931. The reader frustrated by computer-generated bills will be sympathetic to Buchwald's "The Curse." Poetry buffs will find Auden's "The Unknown Citizen" both entertaining and frightening. Those who remember the wide open job market of the midsixties will be taken back to that period by Bylinsky's "Help Wanted: 50,000 Programmers." Political, social and ethical views of computers and computer applications are presented for the philosophically inclined.

VanTassel has succeeded in achieving his goals as put forth in the introduction. He has gathered the cream of computer lore from the thousands of items generated in the past thirty years and has put his book together in such a way that the reader remains entertained and challenged as well as reminded of the bilateral blessing the computer can be. THE COMPLETE COM-PUTER is perfect reading for anyone interested in computers.

SYSTEMS ENGINEERING OF ED-UCATION VI: PRINCIPLES OF COMPUTER-ASSISTED INSTRUC-TION SYSTEMS, Leonard C. Silvern. Education and Training Consultants Co., 179 pages, \$15.00. Paperback.

PRINCIPLES OF COMPU-TER-ASSISTED INSTRUCTION is a discussion of the requirements for organizing and managing a Computer Aided Instruction (CAI) center. Although it is a reasonable collection of most of the data available on CAI, it is not a book that would normally interest the computer hobbyist. Aimed at the educator with little or no

data processing background, it reads much like systems documentation for the internal operations of a particular company. The author is knowledgeable about CAI and presents many valid arguments. He particularly emphasizes the need for a learner-centered approach in the development of instructional packages. He also argues in favor of the CAI processor being machine independent, a point that would be well taken in many areas of the computer industry.

In PRINCIPLES OF CAI Silvern discusses fundamental patterns of approaching problems. He covers this area in great detail, even including the following description of the rectangular used in flow charting: "rectanglea right-angled parallelogram proportioned 5:9 approximately and oriented so the larger side is parallel with the top and bottom edges of the paper, chart, or other display medium."

The description of CAI processors and their specific operation in section D, "CAI Programming and Strategies," is excellent. A computer oriented reader would be wise to concentrate on this chapter, skimming or ignor-

ing the rest of the book.

In many areas Silvern appears to make things more complicated than they are. This is due in part to the verbosity of many passages, in part to the vast amount of detail presented. The author's orientation with respect to complexity, best expressed in Silvern's Law, "Complex problems call for complex solutions and these are most often provided by complex people," also contributes to the apparent confusion. Many of the difficulties encountered in reading this manual, however, would be mitigated, if not eliminated by the inclusion of both an index and a glossary. Terms are defined in the text, but the definitions and references are not readily available when they are needed later.

PRINCIPLES OF CAI was written in 1970, and in several areas the viewpoint is somewhat dated. Silvern places his major emphasis on communication, for example. He also leans Branch to Page 143

MARCH 1977

THE SC/MP

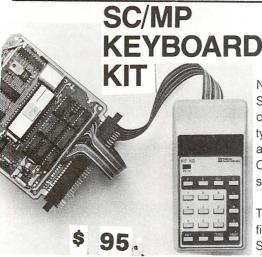
ат \$ 95.00

SC/MP, the Microprocessor kit from National Semiconductor includes everything you need to build a completely functional microprocessor system — featuring the National SC/MP microprocessor — the low cost microprocessor for every application: Text Systems and Instrument Control; Machine Tool Control; Small Business Machines; Word Processing Systems; Educational Systems; Multiprocessor Systems; Proces Controllers; Terminal Control; Laboratory Instrumentation; Sophisticated Games; Automotive Controller and Appliance Controllers.



The kit, neatly packaged with all the components and literature you need, in a looseleaf binder, includes: The SC/MP Microprocessor — a single-chip Central Processing Unit in a 40-

— a single-chiral Processing Unit in a 40-pin, dual in-line package. Features static operations, forty-six instruction types; single-byte and double-byte, software controlled interrupt structure, built in serial input/output ports; bidirectional 8-bit TRI-STATER bus, parrallel data/port and latched 12-bit TRI-STATER address port. ROM — 512 bytes (8-bits/byte) of pre-programmed Read-Only-Memory containing KITBUG—a monitor and debugging program to assist in the development of your application programs, KITBUG provedes teletypewrite input/output routines and allows examination, modification, and controlled execution of your programs. RAM-256 bytes of static read/write memory for storage of your application programs. Transfers of data to and from RAM are controlled by SC/MP and KITBUG. Teletypewriter Interfact including buffer and drive capability for a 20 MA current loop interface. Voltage Regulator. Data Buffer—providing interface between memory and bidirectional data lines. All the literature you need, including schematics and programming manuals. Timing Crystal—providing 1.000 MHz timing signal. Plus all the passive components and circuit board with 72 pin edge connector required to build and interconnect your microprocessor system with external hardware.



This is a great kit for engineers and companies who don't have access to a Teletype. It is a low-cost teaching, learning, and developing tool for hobbyists, professors, students, and electronics entrepreneurs of all levels.

current ranges: \$4.75

ASC II KEYBOARD



(Reg. \$58.85)

\$53.00

This 63 key ASC II Encoded Keyboard kit was designed and manufactured by Electronics Warehouse Inc. Features: single 5 volt D.C. supply, utilizing only TTL logic elements (no MOS devices to blow), TTL drive capability (each of the eight bits of ASC II output will drive the equivalent of ten standard TTL inputs without external buffer drivers), de-bouncing, upper and lower case fully ASC II, 8 bit parallel output. In addition to the alpha-numeric and symbol keys available on a regular keyboard, the following keys are utilized: escape, back-space, tab, line-feed, delete, control, shift-lock, shift-(2 keys), here-is, control-release.

Kit includes: 63 key keyboard, P.C. board, all required components and assembly manual with ASC II code list.

Optional: 1. Parity bit - add \$1.00

Aluminum enclosure \$39.-

2. Serial output - add \$2.00

Note: If you already have this teletype keyboard you can have the kit without it for \$36.00 (reg. \$39.85). Dealer inquires invited.

National's new Keyboard Kit now gives SC/MP Kit users a low-cost input/output capability. This new kit replaces the Teletype* normally required by the SC/MP Kit and allows users to evaluate the SC/MP CPU and to develop a variety of application software.

The heart of SC/MP Keyboard Kit is a ROM firmware package (512 bytes) called SCMPKB. The SCMPKB ROM replaces the "Kit Bug" ROM originally supplied with the SC/MP Kit and allows the effective use of the hexadecimal keyboard, to execute programs, to examine or modify the contents of memory and the SC/MP registers, and to monitor program performance.

There is a hole pattern for additional integrated circuits on the SC/MP Kit PC card. By following the simple instructions in the SC/MP Keyboard Kit users manual, one can add buffers, decoders, drivers, multiplexers, etc. Simply replace the Kit Bug ROM (supplied in the SC/MP Kit) with the new SCMPKB ROM, connect the preassembled Keyboard cable connector to the kit card, and you are ready to go!

National's Keyboard Kit comes complete with manual, all required integrated circuits, resistors, keyboard display cable connector assembly, wire wrap connectors, precut wires—even a hand-held wire wrap tool.

Transistors Diodes I.C.'s CMOS Capacitors Resistors Wires Switches SPST P.C.

THE FIRST FULL FEATURE LSI DMM KIT INTRODUCTORY PRICE: TO CONCORD EW II LOT CONCOR

FROM CONCORD

ORDERING INFORMATION:

SHIPPING AND HANDLING - \$3.00 + \$.50 Insurance

California residents add 6% sales tax.

ELECTRONICS WAREHOUSE Inc.

1603 AVIATION BLVD. REDONDO BEACH, CA. 90278 TEL. (213) 376-8005

WRITE FOR FREE CATALOG

You are invited to visit our store at the above address

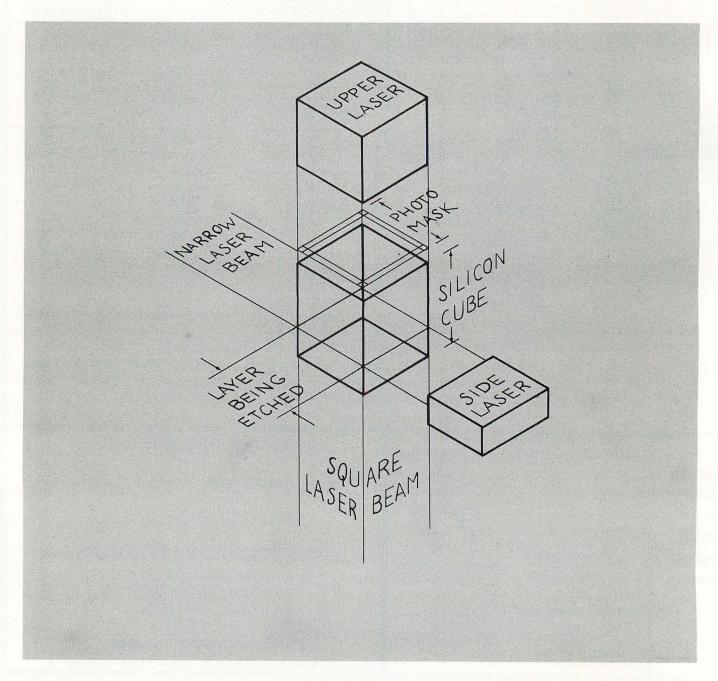
THE QUBE

Roger Garrett

FOREWORD

Each decade of this era shortens the time when science-fiction becomes science-fact. It is a healthy economic community that listens for the whispers from the "Inventor's Corner". Though the process in the following story is still in the conceptual stage, we are strongly reminded by Dr. Hogan in this issue that the marvels of today quickly become the commonplace comforts of tomorrow. Mr. Garrett is President of RICH, Rhode Island Computer Hobbyist Group. Anyone interested in further information, may contact him through RICH, 16 Grinnell St., Jamestown, RI 02835.

-Editor



First, an optically clear silicon buole, doped neutrally with a photosensitive dopant, is formed in the same way as for conventional chip construction. Buole is the term applied to the large mass of mono-crystaline silicon produced by 'drawing' silicon from a molten state. A cube is then cut from the buole and all sides of the cube are polished to optical quality.

The photosensitive dopant is sensitive only to light of two particular wavelengths rated above a certain candlepower. When illuminated above that threshhold the dopant changes from neutral to positive or negative, depending upon the wavelength, and stabilizes, just as a normal photographic emulsion changes its molecular state in the presence of particular colors. Masks are prepared as if they were to be used for normal photoetching on silicon chips.

Two laser beams are used in this method, each one capable of emitting the same two discrete wavelengths such as alpha and beta. Alpha and beta are the chosen wavelengths which turn the dopant to negative and positive, respectively. One beam is a collimated plane of light. It is a straight beam as wide as the cube but only a few millionths of an inch thick—about the same thickness as the epitaxial layers on a chip. The beam's cross section is a rectangle as wide as the cube and as high as a typical epitaxial layer. The second laser is a collimated beam whose width and thickness are both equal to the width of the silicon cube. The beam's cross section is a square.

The cube is placed on a stand with the wide beam illuminating it from above, perpendicular to the top surface and the narrow beam illuminating it from the side with the beam parallel to the top surface. Each beam, by itself, is less powerful than the minimum necessary to affect the photosensitive dopant. However, where the two beams cross the sum is high enough to cause the change from neutral to positive or negative, depending upon the wavelength of the laser light.

The cube is treated as if it were a stack of layers, each one having its own photo-mask as in normal etching methods. The narrow beam is directed through the layer to be 'etched', using the alpha wavelength. The correct mask is placed between the cube and the upper laser, and the upper laser is turned on to the same wavelength, thus 'etching' the layer with the positive mask. The lasers are turned off and the next mask is put in place. Then the negative mask is 'etched' using the beta wavelength. Last the narrow laser is positioned to the next layer and the process repeated. This is continued until the entire cube is 'etched' with the proper pattern of neutral, negative, and positive areas to produce the desired circuitry. At this point it is no longer a simple cube of silicon but a Qube, the newest generation of computer hardware.

One Qube could contain, with proper masking, several CPU's, all necessary ROM and RAM, and

even I/O interfaces. Contacts for the outside world and power supply would be made just as with conventional chips by providing pads for mechanical connections.

A major problem would be reliability since even with today's chips the reject rate can be high. I would suggest that backup systems be employed wherever possible within the Qube. Each memory bit would actually be three bits. The state of each tri-bit would be 1 if at least two of its bits were 1 and 0 if at least two of its bits were 0. In other words, majority rule. The CPU would also use redundancy, perhaps utilizing three CPUs with a majority rule standard.

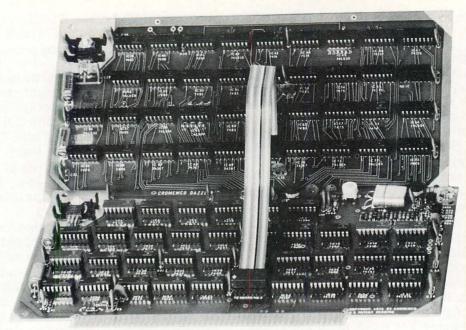
One problem in developing the Qube is finding a suitable photosensitive dopant. Another would be overcoming the tendency of the photo-mask to act as a diffraction grating causing interference patterns rather than the mask pattern to propagate through the cube. A possible solution to this would be to use two crossing narrow beams of lasers whose positions are computer controlled and whose cross sections are each circles with radii equal to the thickness of a typical layer. The point of intersection would be a minute sphere rather than a plane and the etching would proceed from point to point within the cube rather than layer-to-layer as in the above method. With this method no masks would be required and changes could be made to the circuitry design with great ease. It would also facilitate the production of experimental. small quantity, or one-of-a-kind Qubes.

The developer would need only specify a circuit description to the controlling computer, which might rely upon a library of standard circuit designs. OEM users would be able to make their specifications in general terms such as 'two 8080 CPU's, 64k RAM, ROM operating system number AB32, and 7 A/D convertors'.

I believe that the advantages of the Qube would be well worth the effort. Initial costs would probably be high as with much of today's semiconductor industry. Yet costs would surely drop as production rose. The Qube would use less silicon per element, providing more efficient use of silicon real estate, take less time and would require less handling in production.

The Qube can even be tested during production since it would not be necessary to wait for the whole thing to cool to be cut as with conventional chips. After the first layers are 'etched' connections could be made and diagnostics run as the remaining layers are 'etched'. When faulty elements are found a new layer is 'etched' to replace it and the old one 'erased' by bypassing its bus lines.

Imagine a complete multi-processing system with several high level languages fitting into the palm of your hand! There would be no need for time-sharing since every user could have his own dedicated system. By connecting additional non-destructive RAM Qubes we could eliminate the need for mass storage devices like tapes and disks. The field of artificial intelligence would get the hardware it needs to implement the theories which are now only dreams.



CARD OF THE MONTH

CROMENCO TV DAZZLER™

By Roger Edelson

This month I will cover a non-essential but fun card, the Cromemco TV Dazzler™. By now most of you have seen various computer displays, games and motion art and are probably interested in duplicating them. The Dazzler™ allows you to put graphics, games and animated shows on your T.V. in full color or in black and white for merely a little more than you would pay for a black and white terminal. The Dazzler™ costs only \$215 for the complete kit or \$350 for a fully assembled and tested version.

How is this accomplished? The Dazzler maps your computer memory or content onto your color T.V. screen. The device uses DMA (Direct Memory Access) to scan the computer memory. It then formats each memory bit into a point on the T.V. screen to give a 128 x 128 — element picture. Depending on the mode selected, later to be described, the Dazzler requires 512 or 2K bytes of memory — not an excessive amount.

Let us first take a look at the design of the DazzlerTM. The unit is somewhat complex, using over 70 MOS and TTL integrated circuits on two printed circuit boards. The two Dazzler boards may be plugged directly into two adjacent slots in the Altair computer. A 16-conductor ribbon cable with DIP plugs on each end is used to interconnect the two boards. Board #2 may also be mounted "piggyback" on Board #1 so that only one slot of the Altair is required for the Dazzler. In this configuration seven additional jumper wires must be used to interconnect Board #1 with Board #2.

The functional block diagram of the Dazzler is shown in Figure 1. Board #2 is used to communicate with the computer and Board #1 generates the video output signal.

The Dazzler uses high-speed DMA to read the

memory of the host computer and translates the information in the memory into a T.V. signal. The key advantage of using DMA is that the Dazzler can display a picture simultaneously while the computer is executing either a related or an unrelated program. Dazzler causes only 15% slow-down in computer execution.

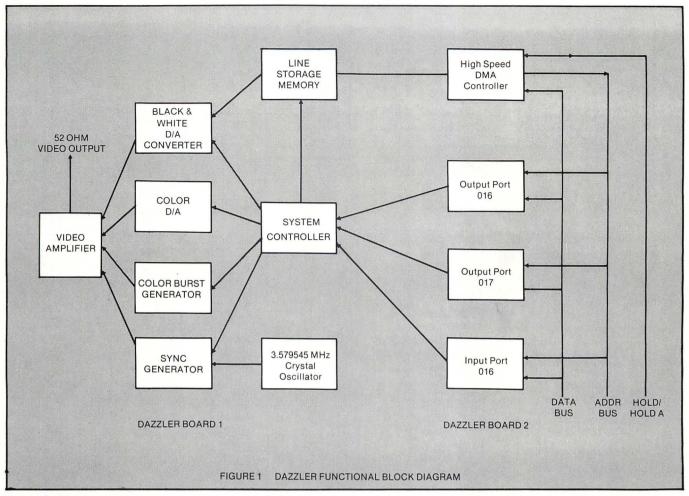
A 3.579545 MHz crystal oscillator is used to generate the color video subcarrier. The video output amplifier delivers a standard 1V negative sync NTSC video signal into a 52 ohm load. A six-foot length of 52 ohm coax cable is supplied with the unit.

The circuit diagram for Board #1 is shown in Figure 2. The oscillator uses a standard chroma crystal to generate the 3.579545 MHz signal. Three inverters and R-L phase-shifting components are used to provide the red and green signals. A group of NAND gates is used to mix the various signals to produce a video output. Vertical and horizontal synch are generated on Board #1.

While we are on the subject of the diagrams, I would like to digress to an editorial comment. I wish that Cromemco would put their parts identification on the schematics. They are *nowhere* to be found except in the board layout. Please, Cromemco; it would really help troubleshooting.

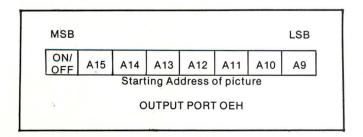
Figure 3 is the circuit of Board #2, the one used to communicate with the computer. This board uses a 1-Megabyte DMA channel with "handshaking" control, i.e. the Dazzler control issues a *Hold* command when it is ready to access the computer memory. When the computer finishes the current machine cycle, it issues a *Hold A knowledge* signal to begin DMA.

In addition to the high-speed DMA two 8-bit output ports of the computer are used to set the



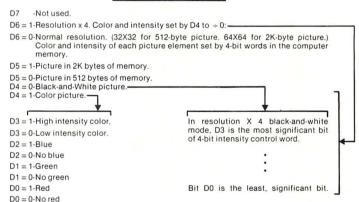
Dazzler modes and addressing. Two bits of the computer input ports are utilized to preset time and framing information to the computer.

The most significant bit of output port OCH is used to enable or disable the Dazzler. A "1" at this bit location turns the Dazzler on. A "0" turns the Dazzler off. The Dazzler can also be turned off manually by depressing the *clear* switch on the Altair front panel. The remaining seven bits of output port OCH are used to set the starting location of the picture to be displayed in the computer's memory. As will be discussed below, the picture may require 512 bytes of memory or 2K bytes of memory depending on the mode in which the Dazzler is operating. In any event this must be **static** memory with an access time of 1 microsecond or faster. A summary of the use of output port OEH is shown below:



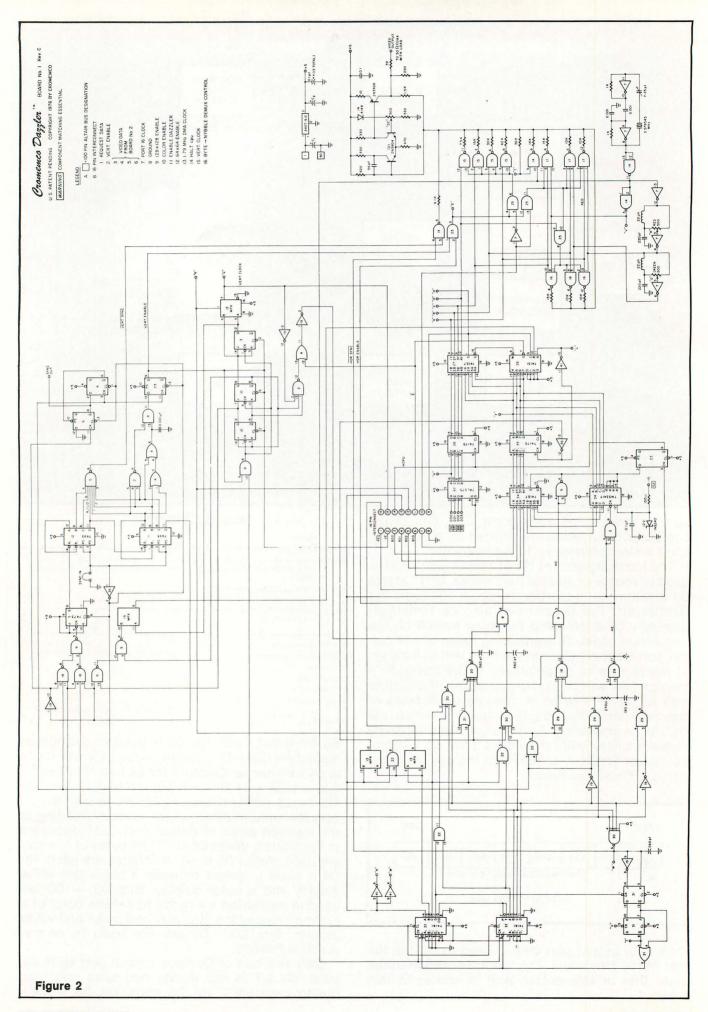
Computer output port OF4 is used to set the format of the TV picture. The function of each of the eight bits of this output port is shown in this table:

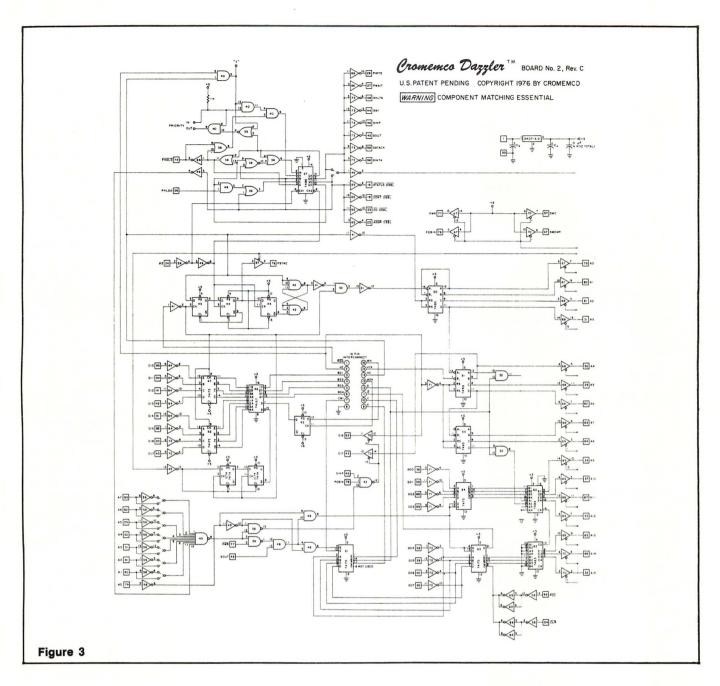
DAZZLER OUTPUT PORT OFH



Bit D7 is not used. Bit D6 is used to set normal resolution (32 x 32 element picture for 512 bytes or 64 x 64 element picture for 2K bytes) or resolution x 4 (64 x 64 element picture for 512 bytes or 128 x 128 element picture for 2K bytes). Bit D5 sets the amount of computer memory (starting at the location given to output port OEH) allocated to the picture. When D5 is "1" 2K bytes of memory are used. When D5 is "0" 512 bytes are used. Bit D4 is used to select between a black and white display and a color display. Bits D3 — D0 are used in resolution x 4 mode to set the color of a color picture or the intensity of a black and white picture. Bits D3 - D0 are not used in normal resolution mode.

Only two bits of Computer input port OEH are used. Bit D7 is low during odd lines and high during even lines. Bit D6 goes low for 4 milli-





seconds between frames to indicate end of frame.

D7 ODD LINE/ EVEN LINE		ONLY TWO BITS OF COMPU- TER INPUT PORT OEH ARE USED.
------------------------------	--	--

In order to generate a TV picture with Dazzler, the information that the Dazzler reads from the computer memory must be properly formatted. In resolution x 4 mode each point on the TV screen is controlled by just one bit in the computer memory. When that bit is a "1" the corresponding element of the picture is on. When that bit is a "0" the picture element is off. In resolution x 4 mode the color and intensity of the picture is set by bits D0 to D3 of the control word at output port 017. For full color in resolution x 4 mode, multiple frames of different colors must be interleaved.

In normal resolution mode the color and intensity of each element of the TV picture are controlled by a four-bit "nybble" in the computer

memory. Two elements of the picture are thus stored in each byte (8 bits) of memory. (For this reason a 64 x 64 picture in normal resolution mode requires 2K of memory.) The lowest order bit of each nybble (D0) determines whether the corresponding element of the picture contains red (1) or no red (0). Similarly D1 controls green, D2 controls blue, and D3 sets either high intensity or low intensity color. In black and white mode these four bits are instead used to specify one of 16 levels of gray.

When writing programs for Dazzler displays it is important to remember that the TV picture is stored as a specially coded sequence in the computer memory. The Dazzler simply interprets this code to form a T.V. picture. Two different codes are used depending on whether the Dazzler is used in normal resolution mode or in resolution x 4 mode (as set by the control word sent to output port 017).

In normal resolution mode four bits of computer

MARCH 1977 INTERFACE AGE 107

memory are used to code each element of the picture. A 32 x 32 picture requires 512 bytes of memory. A 64 x 64 picture requires 2K bytes of memory. The following diagram shows how the 4-bit code works:

RED BLUE GREEN HI/LO RED BLUE GREEN HI/LO

LSB One picture element MSB Adjacent element

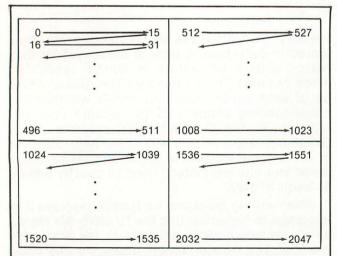
IN NORMAL RESOLUTION MODE ONE BYTE OF MEMORY IS USED TO REPRESENT TWO ADJACENT ELEMENTS OF THE PICTURE.

In resolution x 4 mode each bit of the memory is used to either turn on or off a single element of the picture. The eight picture elements controlled by a single byte have the following geometric relationship:

D0 LSB	D1	D4	D5
D2	D3	D6	D7 MSB

IN RESOLUTION X 4 MODE ONE BYTE OF MEMORY IS USED TO REPRESENT EIGHT ADJACENT ELEMENTS OF THE PICTURE.

The 2K byte Dazzler picture is stored in memory as four quadrants. Each quadrant of the picture occupies one 512-byte page of memory. Only one page of memory is displayed for a 512-byte picture. The sequence in which memory is scanned in making a 2K byte picture is shown below:



MEMORY MAP OF DAZZLER PICTURE. FIRST QUADRANT IS DISPLAYED FOR 512-BYTE PICTURE. ALL FOUR MEMORY QUADRANTS ARE DISPLAYED IN 2K BYTE PICTURE.

Now that we have looked at the operation of the Dazzler, let us look at the kit itself. As I mentioned earlier, it is a two-board kit containing over 70 ICs. Board #2 has 37 ICs and no other component except the 5V regulator and some noise and filter capacitors. Board #1 also contains 37 ICs in addition to the oscillator and various other discrete components.

Both boards are high quality with gold-plated edge board connector pins. The kit is fully socketed for all ICs — point which always gladdens my heart. The boards are equipped with very high quality solder masks which even surround each individual IC pin — a great help. Component silk-screen masking is excellent with all identifications clearly readable. The adjustment potentiometers and oscillator trimmer are placed at the top of Board #1. For easy access I would prefer a coax cable connector in place of merely soldering the cable to the board. Since the cable is the small LG-174/U, a small connector could easily have been placed in the area where the cable exits. I soldered an OSM 244-2 connector in that upper right corner on its side as a later modification.

Both boards are easy to build and the instructions, though seeming sparse, are adequate. No notes are included on board cleaning which should be done after completion of the construction phase.

The two boards are connected by a flexible flat cable and take two slots in the mother board. Since a method of "piggy-backing" is available, I would like to see hardware designed to hardmount the two boards together as a single unit which would plug in to two slots. This would make handling the Dazzler an easier task.

A test program is included for initial operation and tuneup. Addresses are in OCTAL. To operate this program you must have 2K bytes of static memory beginning at location *zero* in memory.

Memory location	Memory contents	Comments
000 000	076	Move immediate into
000 001	200	the accumulator
000 002	323	Output to port
000 003	016	number 016
000 004	333	Input from the
000 005	377	sense switches
000 006	323	Output to port
000 007	017	number 017
000 010	303	Jump to memory
000 011	000	location 000 000
000 012	000	

This program begins by putting the bit sequence "10000000" into the accumulator and outputting it to port 016. This turns on the Dazzler and tells it that the picture that it is to display begins at location zero in memory. Next the program uses

the front panel sense switches to set the control word sent to output port 017. This allows the user to experiment with different output formats and appreciate the fantastic versatility of the Dazzler display. When sense switch A12 is raised the Dazzler goes into color mode, and a colorful quilt-like pattern will appear on the TV screen.

Another personal gripe — I wish Cromemco had done everything in HEX rather than OCTAL. I feel much more familiar with HEX and hate to switch

back and forth.

The troubleshooting guide is very comprehensive with 49 items included in the kit manual. The test equipment requirements are a VTVM (or VOM) and a *triggered* sweep-scope (DC-5MHz) with an

external synch input.

Fortunately my Dazzler came up running the first time. I assume that to be luck, not skill for I am too "experienced" to follow instructions. I've connected the Dazzler to a small black and white set which is at present adequate for my uses. I would ultimately like to connect it to a color set, but at the moment would have to overrule my family's objections to "butchering" our one color T.V.

There is an alternate answer to this problem. The Dazzler can be connected to the antenna terminal of the T.V. rather than to the video amplifier, but to do this an R.F. modulator is required. Such a modulator is the Pixieverter Model XPXV-2A available for \$8.50 from ATV RESEARCH, 13th and Broadway, Dakota City, Nebraska 68731. If you use a Pixieverter you *must* also use a matching transformer between the output of the Pixieverter and the TV set. A standard 75 ohm to 300 ohm matching transformer, available at TV supply stores, will provide the required matching. (Radio Shack stores carry such a transformer for \$2.59, model #15-1140).

While on the subject of T.V. connection, it would be useful if Cromemco included some typical video amplifier connection diagrams to help the process. However, most of our readers have already seen the excellent articles on T.V. hookups in BYTE Magazine.

Cromemco has various programs already available for the Dazzler. They are:

1. DAZZelmation - an animation program

2. KALEIDOSCOPE - a random colorful picture generator

3. DAZZelwriter - an extensive alphanumeric display

4. THE BONE

OF LIFE - a full-color version of LIFE

For those of you with joystick analog inputs for your computer, Cromemco has DAZZLEDOO-DLE and CHASE available. Hopefully the Cromem; co Joystick and D-7A module will be the subject of another article.

In summary the Dazzler is a well-planned design, capable of extending the versatility and capabilities of your computer while providing enjoyment for you and your family with this exciting art form.

TO SERVE YOU BETTER!

BITS N BYTES

Announces:

BITS N BYTES #2

Opening soon in San Diego!
Call (714) 422-0889 for info
Our Product Lines:

Digital Group

IMSAI

Solid State Music

Lear-Siegler

Soroc

Okidata

Tarbell

Pickles & Trout

TDL

PolyMorphic Systems

Vector Graphic

BITS N BYTES

679 "D" South State College Blvd. (College Business Park) Fullerton, CA 92631

(714) 879-8386

Hours: M-F 6 p.m.-9 p.m., Sat. 12-6 p.m.

CIRCLE INQUIRY NO. 65

THE NEW

BYTE SHOP

OF MIAMI

the affordable computer store

7825 BIRD ROAD

(305) 264-2983 DIAL 264-BYTE MIAMI, FL 33155

#1 IN SOUTH FLORIDA

Microcomputer kits, tools, computer system, books, hobby magazines, software (programs), expert advice, repairs, parts, chips, etc. All kits guaranteed. For hobby, business, office, schools or profession.

Join our classes and workshops-whether a beginner or an expert. Come in and browse or play real computer games. Let us show you how to use the new microcomputers for any application. Computer club information.

SPECIALIZING IN SYSTEMS

OPEN: 10-6 Daily & Sat. 10-9 Thur.

CIRCLE INQUIRY NO. 66

MARCH 1977

INTERFACE AGE 109

HARDWARE

This month's bill of fare will be a potpourri of IC chips of interest to the home computerist. For those of you interested in Input/Output, (and who isn't?) let us look at the Siliconix line of DG 300 Series High-Speed CMOS Analog Switches.

The DG 300 series features a latchproof monolithic CMOS switch with a driver. Four different switching functions SPST, SPOT, DPST, and dual SPDT are provided in both CMOS input compatible (DG 304-307) and DTL, TTL, CMOS compatible (G 300-303).

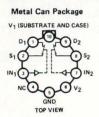
The entire family features low and nearly constant ON resistance (less than 50') over the full analog signal range. One of the benefits of an MOS analog switch element is that in the ON condition the switch will conduct current in either direction with no offset voltage. In the OFF condition, the switches will block voltages up to 30V peak-to-peak. The switching speed is extremely fast with a Ton = 150 nanosecs typical for the TTL version and TON = 110 nanosecs for the CMOS compatible version.

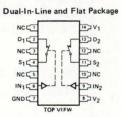
A logic input driver controls the ON/OFF state of the switches and provides the compatibility with the various forms of logic. The DG 300-303 switches are compatible with DTL, TTL, and CMOS having a logic "0" state with an input less than 0.8V and a logic "1" state with an input in excess of 4V. The DG 304-307 switches are CMOS input compatible and have a logic "0" state with an input less than 3.5V. For this series a logic "1" state is guaranteed when the logic input exceeds 11V (for 15V positive supplies). The logic inputs are protected against overvoltage up to $V_1 \pm 32V$, i.e., 32V above or below the positive supply. All the terminals of the analog switch are protected against static discharges. The analog signal input range is $\pm 15V$ (with ± 15V supplies). The following is a brief summary of the feature of the DG 300 series:

- Analog switching with low quiescent power consumption
- No LATCH-UP (under any conditions)
- ± 15V analog signal range (with ± 15V supplies)

PIN CONFIGURATION

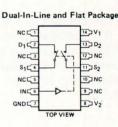
DUAL SPST DG300/304



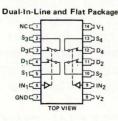




SPDT DG301/305



DUAL DPST DG302/302



DUAL SPDT DG303/307

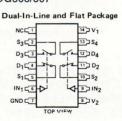


Figure 1. SWITCH STATES ARE FOR LOGIC "1" IN-PUTS (POSTIVE LOGIC)

REPORT

By Roger Edelson

ABSOLUTE MAXIMUM RATINGS	
V_{1N} to Ground V_1 +32 V, V_1 -36 V	Power Dissipation*
V _S or V _D to V ₁ 0, -36 V	14 Pin Sidebraze DIP (P)** 825 mW
V _S or V _D to V ₂ 0, +36 V	14 Pin Plastic DIP (J)***
V ₁ to Ground	Metal Can (A)****
V ₂ to Ground	Flat Package (L)*****
Current, Any Terminal (Except S or D) 30 mA	
Current, S or D, Continuous	
Pulsed 1 ms 10% Duty Cycle 100 mA	*Device mounted with all leads welded or soldered to
Operating Temperature (A Suffix)55 to +125°C	PC board.
(B Suffix)20 to +85°C	**Derate 11 mW/°C above 75°C
(C Suffix) 0 to +70°C	* * * Derate 6.5 mW/°C above 25°C
Storage Temperature (A & B Suffix)65 to +150°C	**** Derate 6 mW/° C above 75° C
(C Suffix)65 to +125°C	*****Derate 10 mW/°C above 75°C

ELECTRICAL CHARACTERISTICS

All DC parameters are 100% tested at 25°C. Lots are sample tested for AC parameters and high and low temperature limits to assure conformance with specifications.

			Max Limits												
		Cha	racteristics				/B Suffi	×		C Suffix	•	Unit	Test Conditions V ₁ = +15 V, V ₂ = -15 V, Gnd = 0 V		
					Typ ¹ 25°C	-55°C/ -20°C	25°C	125°C/ 85°C	0°C	25°C	70°C		$V_1 = +15 \text{ V}, V_2 = -15 \text{ V},$	Gnd = 0 V	
1			Drain Source		30	50	50	75	50	50	75		V _D = +10 V, I _S = -10 mA		
2		^r DS(on)	ON Resistance		30	50	50	75	50	50	75	Ω	V _D = -10 V, I _S = +10 mA	Note 2	
3			Source OFF		0.1		1	100		5	100		V _S = +15 V, V _D = -15 V		
4	S W	S(off)	Leakage Current		-0.1		-1	-100		-5	-100		V _S = -15 V, V _D = +15 V	Note 2	
5	T C		Drain OFF		0.1		1	100		5	100	nA	V _D = +15 V, V _S = -15 V	IVOIE 2	
6	Н	D(off)	Leakage Current		-0.1		-1	-100		-5	-100		V _D = -15 V, V _S = +15 V		
7		1	Channel ON		0.1		1	100		.5	100		V _D = V _S = +15 V	Note 2	
8		¹ D(on)	Leakage Current		-0.1		-2	-200		-5	-200		V _D = V _S = -15 V	Note 2	
9	N	INH	Input Current	DG300-303 Only	-0.001	-1	-1	-1		-1			V _{IN} = +5 V		
10	P U	TINH	Input Voltage High	DG300-307	0.001	1	1	1		1		μА	V _{IN} = +15 V V _{IN} = 0		
11	T S	INL	Input Current Input	t Voltage Low	-0.001	-1	-1	-1		-1					
12		ton	Turn ON Time	DG300-303	150		300						See Switching Time Test Circuit See Break-Before-Make Time Test Circuit		
13		^t off	Turn OFF Time	Only	130		250								
14		ton	Turn ON Time	DG304-307	110		250				*	nS			
15		^t off	Turn OFF Time	Only	70		150								
16	D Y N	t _{on} - t _{off}	Break-Before-Make Interval	DG301/303 DG305/307 Only	50										
17	A M	C _{S(off)}	Source OFF Capaci	tance	14								V _S = 0, Note 2		
18	C	C _{D(off)}	Drain OFF Capacita	ince	14								V _D = 0, Note 2		
19		C _{D(on)} + C _{S(on)}	Channel ON Capaci	tance	40							pF	V _D = V _S = 0, Note 2	f = 1 MHz	
20		C	Janua Cananitanaa		6								V _{IN} = 0		
21		CIN	Input Capacitance		3.5								V _{IN} = +15 V	1	
22			OFF Isolation ³		62							dB	V _{IN} = 0, R _L = 1K 12, C _L = V _S = 1 V _{RMS} , f = 500 kHz		
23		11	Positive Supply Cur	rent	0.23	1	0.5	0.5		1		mA	4 4 4 4 6 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	10.1	
24		12	Negative Supply Cu	rrent DG300-303	-0.001	-10	-10	-100		-100			V _{IN} = 4 V (One Input) (AI	Other Inputs = 0	
25	s	11	Positive Supply Cur	rent Only	0.001	10	10	100		100			V - 08 V (AII I= -)		
26	U	12	Negative Supply Cu	rrent	-0.001	-10	-10	-100		-100			V _{IN} = 0.8 V (All Inputs)		
27	P	11	Positive Supply Cur	rent	0.001	10	10	100		100		μА	V +15 V (All Ice)		
28	Y	12	Negative Supply Cu	rrent DG304-307	-0.001	-10	-10	-100		-100			V _{IN} = +15 V (All Inputs)		
29		11	Positive Supply Cur	rent Only	0.001	10	10	100		100			V = = 0 (All Inputs)		
30		12	Negative Supply Cu	rrent	-0.001	-10	-10	-100		-100			V _{IN} = 0 (All Inputs)		

- 1. Typical values are for DESIGN AID ONLY, not guaranteed and not subject to production testing
- 2. V_{IN} = Input voltage to perform proper function, DG300-303: V_{IN} For logic "1" = 4 V, for logic "0" = 0.8 V DG304-307. V_{IN} For logic "1" = 11 V, for logic "0" = 3.5 V 3. "OFF" Isolation $\stackrel{\triangle}{=}$ 20 log V_S/V_D , V_S = Input to OFF switch, V_D = Output

DG300 ICMA-A DG302 ICMB-A DG301 ICMA-B DG303 ICMB-B

DG304 ICMA-C DG306 ICMB-C DG305 ICMA-D DG307 ICMB-D RDS < 50^r over signal range

 Fast switching speed—TON = 150ns typ (DG 300-303)
 TON = 110ns typ

(DG 304-307)

- DG 300-303 TTL, DTL, CMOS Input compatible
- DG #304-307 CMOS input compatible
- · All terminals protected against static discharges
- Logic input protected to V₁ ± 32V.
- Four different switch functions to give optimum flexibility.

The following are the switching pin configurations: (See Page 111.)

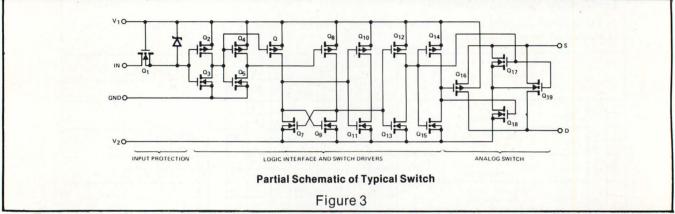
Let us review the electrical characteristics shown in Figure 2. The first section covers the absolute maximum ratings. Exceeding these ratings will either damage the chip or certainly cause improper operation. (See Page 112.)

Looking at the electrical characteristics sections, 1-8 cover those parameters of the switch portion of the DG 300 series.

signal. With a 1Vrms will appear at the output.

Items 23-30 indicate the power usage of the switch under various conditions.

Let us take a brief look at the switch. Figure 3 is a partial schematic of a DG 300 switch. Device Q₁ along with the zener diode provides the input protection. This is accomplished by Q, being turned off whenever the input voltage exceeds the positive supply (V_1) and by the zener breakdown whenever the input goes more negative than $V_1 - V_{ZENER}$. Q_2 and Q_3 form the first input buffer and are designed to set the proper input threshold. The DG300 to DG303 thresholds are typically between 1.5 and 2.5 volts and are designed to interface with TTL gates employing pull-ups to +5V. These switches can also be driven from CMOS gates using 5 to 15 volt supplies. If 15 volt CMOS drive is available, faster switching can be accomplished by using the CMOS input DG304 to DG307 switches. DG304 to DG307 switch inputs have thresholds typically between 4 volts and 6 volts with ± 15 V supplies and are designed to interface with inputs switching between ground and



The source resistance allows the calculation of the maximum offset error to be expected in use. Analog switch currents of 100 μ A will produce a less than 5mV offset voltage. A 10 μ A current will produce less than 1 mV error. Items 3-8 cover the switch leakage currents. These currents will produce an error voltage during the "OFF" condition. With a 10K source resistance the maximum leakage current will produce less than .1mV error.

Parameters 9-11 indicate the input currents expected at the logic input. These values are easily compatible with TTL or CMOS logic.

The dynamic parameters which govern the operation during switching or a.c. input conditions with *Turn-on* and *Turn-off* times are given for both series. Parameter 16 indicates the typical value of time between the breaking of one set of contacts and the making of the other set. In all cases the switch will not short one input to the other (guaranteed break-before-make action).

The capacitance parameters determine the switch's performance to a.c. signals. With 10K source resistance, the input time constant will be .4nanosecs. This would give an 8% error to a 1nanosec rise time signal and less than a 2% error for a 2nanosec input signal.

Parameter 22 provides indication of how much feed through the switch will have to a 500 KHz

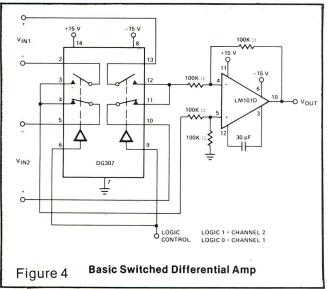
the + 15V supply. Q_4 through Q_{15} form additional buffers and create the necessary driving voltages for the switch devices, Q_{16} through Q_{19} . Q_{17} and Q_{18} are referred to as being body snatchers, not because of midnight escapades, but because they connect the body of Q_{19} to either its source or the negative supply. This reduces the ON resistance and the OFF leakage of this device.

The major use of the DG 300 series switches is for data multiplexing. Figures 4, 5 and 6 illustrate various applications. Figure 4 shows a basic switched differential amplifier. As can be seen, both lines of the two inputs are switched in a differential fashion. When the logic control signal is a "1", the channel 2 is selected and when "0", channel 1 is selected. Because of the break-before-make action, the two inputs will not be shorted together during switching.

In Figure 5 the differential amplifier has been improved to give even better common mode rejection. A position or offset adjustment has been added

In Figure 6 (page 114) we find a 64-channel 2-level data multiplex system. By virtue of a 2-level system slow speed switches of the DG 500 series may be used to multiplex 16 inputs to a single line. These switches may be 1-3 μ sec series will give moderate to high leakage current. The DG 300

series switches are used in the second level to multiplex 1 of 4 lines to the output line. A comparison of the two-levels vs one-level scheme is given, indicating a factor of six increase in switching speeds and a 2.5 decrease in leakage currents.



The high switching speed of the DG304 is taken advantage of in the 64-channel two level multiplex system of Figure 6. This circuit employs 4 each DG506 16-channel multiplexers as the first MUX level and uses the high speed DG304's in the second level to switch between DG506 outputs. CMOS digital logic forms the address logic for the multiplexers as well as the DG304's.

As one multiplexer is being sampled at the output, the other multiplexers are being switched to the next address line. This allows the overall system transition time to be shortened from 1.5 μ sec to 0.25 μ sec. The two level system also lowers output mode capacitance and output leakage.

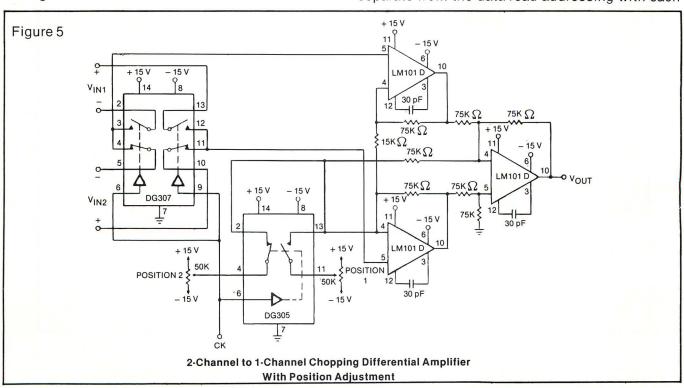
Now let us take up a nifty little part which will make it very easy to interface asynchronously with a computer. The chip is a 74170 16-bit 4-by-4 Register File. These 16-bit TTL Register Files are organized as four words of four bits each. Separate on-chip decoding is provided for addressing the 4-word locations to either the write-in or retrieve data. This permits simultaneous writing into one word location and reading from another.

Four data inputs are available to supply the 4-bit word to be stored. Location of the word is determined by write-address input A and B in conjunction with a write-enable signal. Data applied at the inputs should be in their true form. That is: if a high-level signal is desired from the output, then a high-level signal must be applied at the particular data input for that bit location. The latch inputs are arranged so that new data will be accepted only if both internal address gate inputs are high. When this condition exists, data and the D input is transferred to the latch output. When the write-enable input (L+W) is high, the data inputs are inhibited and a change in their levels can not change the information stored in the internal latches.

When the read-enable input (GR) is high, these data outputs are inhibited and remain high. This means both *enables* are inverted logic. Negative signals enable the particular area and positive signals inhibit.

The individual address lines permit direct reading of data stored in any four of the latches. Four individual decoding gates are used to complete the address for reading a word. When the read address is set up in conjunction with the read-enable signal, the word appears at the four Q outputs.

This arrangement—data entry addressing separate from the data-read addressing with each



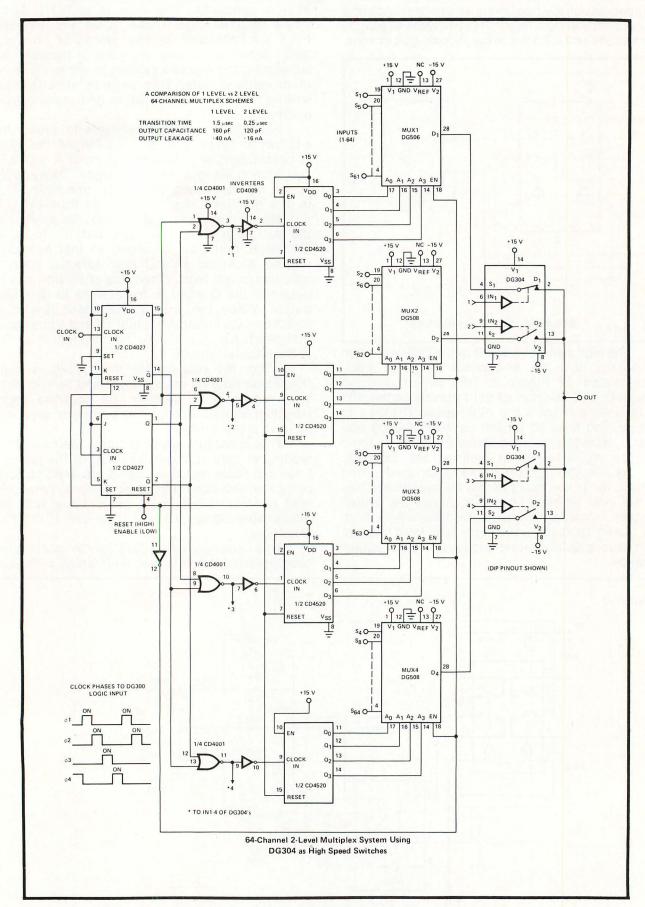


Figure 6

data bit having an individual sense line—eliminates recovery times. It permits simultaneous reading and writing with speeds limited by only the *write* time (30 nanosecs typical) and the *read* time (25 nanosecs typical). The register file has a non-destructive readout in that data are not lost when addressed.

The correction diagram and truth tables for read and write are shown in Figure 7.

Figure 8 is the logic diagram of 74170. (See Page 116.)

All 170 inputs and all inputs except the read-enable and write-enable of the LS170 are buffered to lower the drive requirements to one standard load. Input-clamping diodes minimize switching transients to simplify system design. High-speed, double-ended AND-OR-INVERT gates are employed for the read-address function and drive high-sink-current, open-collector outputs. Up to 256 of these outputs may be wire-AND connected for increasing the capacity up to 1024 words. Any number of these registers may be paralleled to provide n-bit word length.

Features

- Separate addressing permits simultaneous reading and writing
- Fast access times typically 20 ns
- Organized as 4 words of 4 bits
- Expandable to 1024 words of n-bits
- For use as:

Scratch-pad memory

Buffer storage between processors

Bit storage in fast multiplication designs

Open-collector outputs with low maximum offstate current:

170 LS170 30 μA 20 μA National Semiconductor also makes a 670 part with tri-state outputs which may be connected to a bus-line.

Another useful IC is the DM 8131/36, a 6-bit Unified Bus Comparator. The circuit diagram, correction diagram and truth table for this ubiquitous device are shown in Figure 9. See Page 117.

Electrical characteristics are shown on Figure 2. The comparator in this design compares two binary words of 2-to-6-bits in length and it indicates when the two words match (bit-forbit). Both active pull-up outputs (low state for $W_1 = W_2$) and open-collector outputs (low state for $W_1 = W_2$) are available. The latter devices may be used where necessary to expand the comparison to nano-bits by collector—ORing. Don't forget to add the required resistor pull-up.

The nice advantage of these comparators over AND/OR gating is the savings in chip count and the comparator has a high impedance bus interface.

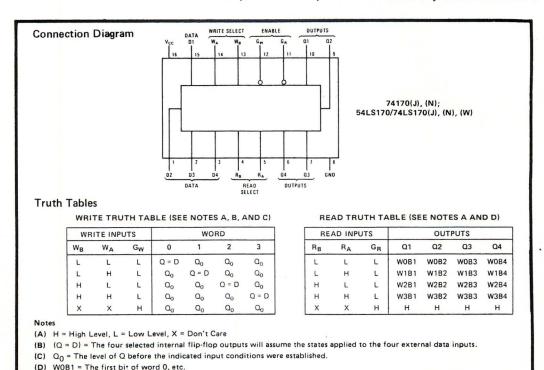
One input requires a maximum of 50 μ A input current and is obviously ideal for address-decoding on the unified bus systems. The other bit comparator input is TTL compatible (though the bus side will obviously also work from a TTL input.) The bus input has 0.65 hysteresis to provide 1.4V typical noise immunity. The bus inputs comply with the IEEE 488-1975 interface specifications.

The output circuitry of the comparator contains latching feedback which provides the capability of holding the output state during non-strobe times.

The transfer of information to the output occurs when the STROBE input transitions from logic "1" to logic "0" (high to low). Input may be changed while the STROBE is at logic "1" level without affecting the state of the output.

This device is outstanding as an address comparator for memory and I/O boards.

Figure 7



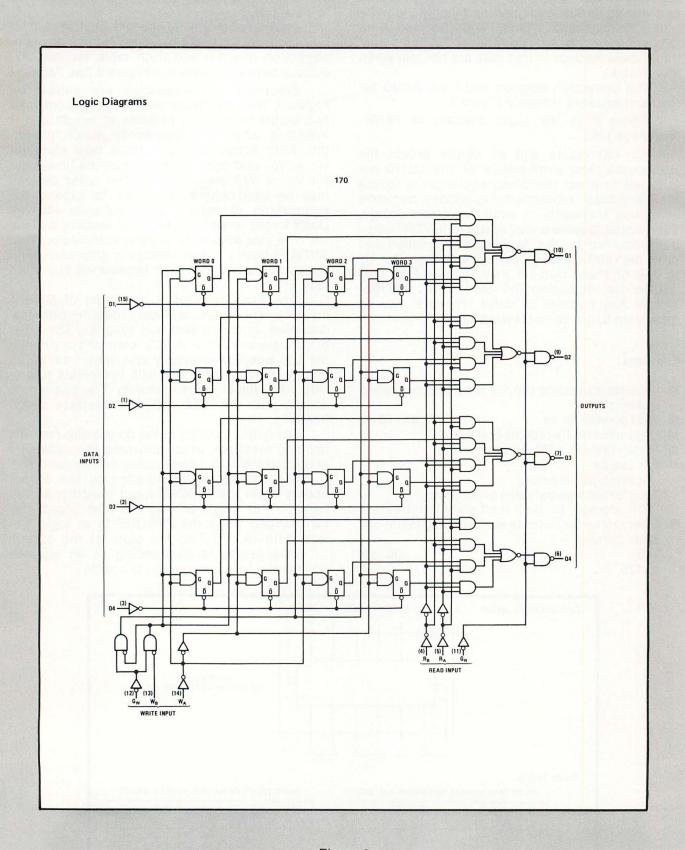


Figure 8

116 INTERFACE AGE MARCH 1977

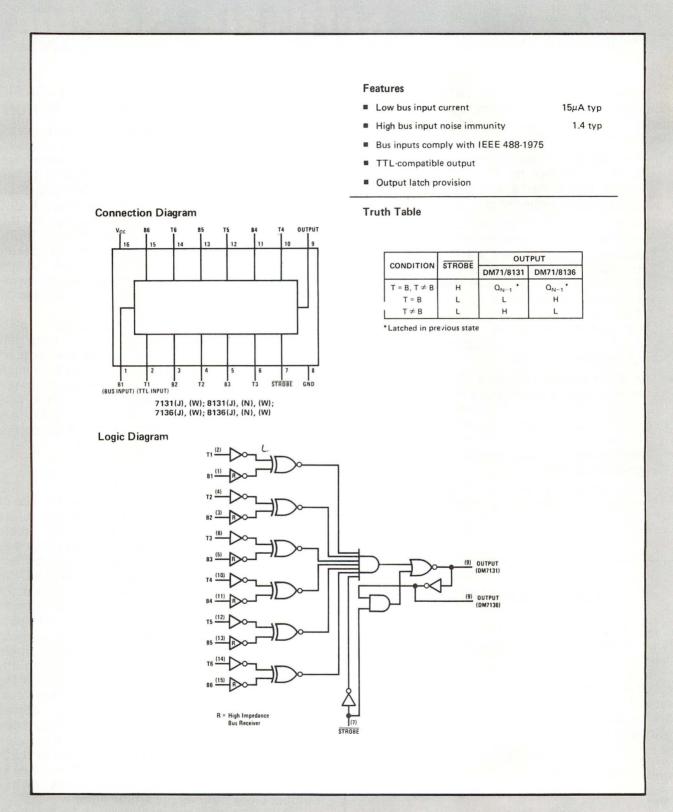


Figure 9

Software Section

This month's issue of INTERFACE AGE includes articles on software, development programs, a short graphics theme and a game program. The software articles are:

- An 8080 Octal Debugging Program (ODT-80) by E. R. Fisher for the LLL BASIC Interpreter. This is Part 4, last in the series on the LLL BASIC Interpreter program.
- A resident 6800 Re-entrant Self-Relative Subroutine Firmware package called (RS)³ provides additional development software subroutines to AMI's PROTO monitor firmware for the EVK microcomputer. Both PROTO and (RS)³ firmware are included as part of the total EVK microcomputer package. (RS)³ was developed by American Microsystems who have kindly made it available to the readers of INTERFACE AGE.
- A short article: Graphics, The Easy Way by Marvin Mallon on utilizing PolyMorphic Systems' Video Terminal Interface (VTI) board provides an insight into using the VTI board to generate the full upper and lower case alphanumeric characters and to generate 64 graphic symbols.
- Z-80 MITS 12K Extended BASIC Program Patches by Martin D. Gray provides the required software patches to the MITS Extended BASIC for execution by the Z-80 CPU.

SOFTWARE BUGS

ARTICLE — Dr. Wang's Palo Alto Tiny BASIC by Roger Rauskolb starting on page 92 of our December issue.

Roger reports that a software addition must be added to resolve the -0 condition for the CHGSGN subroutine on page 103. Insert the following 8080 Source Code after memory address 0486 Op Code MOV A,H as shown and reassemble Source Code:

CHGSGN:

0486	7C	MOV	A,H	; *** CHGSGN ***
		XTR	L	*
insert		RZ		
		MOV	A,H	P
**	F5	PUSH	PSW	
	2F	CMA	4 3	; CHANGE SIGN OF HL
	67	MOV	H,A	

CALL FOR INFORMATION ON BASIC PROGRAMMING LANGUAGES—RERUN

INTERFACE AGE is conducting a survey on the characteristics and programming power of microcomputer BASIC conversational programming languages. This survey includes Tiny BASIC (TB), Tiny BASIC Extended (TBX), Standard BASIC (SB), Standard BASIC Extended (SBX) and Business BASIC (BB) languages. One of the many objectives of this survey is to highlight the correlation between BASIC languages in order to provide insight for running a BASIC application program on any of the different BASIC languages. At the completion of this survey, the results will be published in INTERFACE AGE.

If you have developed, helped develop, or modified any BASIC type of programming languages for any microcomputer, please contact or send hard copy of grammar, user's manual, copy of software and any supporting documentation to Robert A. Stevens, software editor, INTERFACE AGE. Please include your home and work telephone numbers (for coordination) with all correspondence.

INTERFACE AGE NEEDS YOUR VOTE

Help INTERFACE AGE determine the type of articles you want to see published in the future by casting your vote of 10 points for the article (block voting) or articles (by vote splitting) you liked best. Feedback will provide encouragement to authors and will help make the INTERFACE AGE The microcomputer magazine of the industry.

Each INTERFACE AGE magazine shall include one original bingo voting card. Each individual possessing a bingo voting card shall be allowed up to ten votes to be cast as a total single vote block for one author or subdivided into any vote block segment size combinations, with the total cast vote sum not to exceed ten, cast between two or more authors (no xerox copies of the bingo vote card please). Each published article is assigned a block of 10 bingo card numbers with the last digit of the number (LSD) to represent your cast vote value. O represents a vote value of 10. The prefix digits of the number block defines the article number.

All valid bingo vote cards must be postmarked prior to 12:00 P.M. of the last day of the month following the issue date of the related magazine.

HALF SIZE PROGRAM LISTINGS VS FEWER PROGRAMS UPDATE

Full size or near full size xerox copies of software published in half size format will be avail-

118 INTERFACE AGE MARCH 1977

able from the Microcomputer Software Depository (MSD). See MSD program listing for details.

INTERFACE AGE WILL PAY UP TO \$50/PAGE FOR SOFTWARE

INTERFACE AGE is continually soliciting original unpublished quality documented highly commentated source/object code software listings and software technical articles for publishing in the INTERFACE AGE. Manuscript text must be typed double spaced with wide margins. Figures, tables, flow diagrams and charts must be numbered and submitted on separate sheets of white bond paper (Send original copy only). Program listings must be printed on white clean paper using a new black ink ribbon, and please, if possible, supply a punched paper tape assembly (source + object) code listing + source code listing + object code dump with your hard copy. Be sure to record your name, company and office and home telephone numbers on all materials submitted to the software editor. Also include statement in cover letter allowing INTERFACE AGE and the Microcomputer Software Depository to publish and distribute copies of your software program. Include a prepaid postage stamped envelope with your return address only if you want your manuscript returned, in the event that the submitted article is not accepted for publication.

Articles accepted and published will receive an honorary recognition award. Honorariums are based upon technical content, manuscript preparation and subject suitability for publication in INTERFACE AGE. Honoraria range from \$15.00 to \$50.00 per typeset magazine page. In addition, the best article of the month submitted will receive a \$100 bonus. INTERFACE AGE'S readership will determine by vote which is the best article. (See best article of the month award). All software submitted to INTERFACE AGE will be deposited in the Microcomputer Software Depository (MDS) for low cost distribution.

Address all software correspondence to R.A. Stevens, Software Editor, c/o INTERFACE AGE Magazine, 2361 E. Foothill Blvd., Pasadena, CA 91107 or call (213) 449-1655.

BEST ARTICLE OF THE MONTH AWARD UPDATE

INTERFACE AGE will bestow an Honorary Award of \$100.00 to the author of the best non-commercial microcomputer article of the month. Only individuals are eligible for this monthly honorarium. This monthly award is in addition to the honorarium given on the page count basis. Microcomputer articles may be on hardware, software or a combination hardware-software and will be judged by the INTERFACE AGE readership.

BEST ARTICLE OF THE YEAR AWARD

INTERFACE AGE will bestow an Honorary

Award of \$500 value in products advertized in INTERFACE AGE to the author of the best non-commercial microcomputer article published during 1977. The best article of the year award will be picked from the group of the best article of the month awards. Like the best article of the month award, only individuals are eligible for this yearly honorarium. The yearly award is in addition to the monthly award and honararium given on the page count basis. The yearly award will be judged by the editors of INTERFACE AGE and will be announced in February 1978 issue of INTERFACE AGE.

SOFTWARE SHOPPING LIST

Now that INTERFACE AGE has expanded the microcomputer software coverage and developed a large appetite for good software, your programs and application software is badly needed to satisfy this enlarged software appetite. This software shopping list includes the following:

 Microcomputer Development Software such as assemblers, disassemblers, editors, monitors, utilities, mini-maxi BASIC interpreters and compilers, FORTRAN interpreters and compilers, boot strap loaders, software drivers, cassette software operating systems (COS), floppy disc software operating systems (FDOS), TTY software operating systems (TTYOS) for all microcomputer configurations.



CIRCLE INQUIRY NO. 67

announces the availability of

Byt-8

the NEW LOW PRICED MICROCOMPUTER you've heard and read about that's high in flexibility!!!

CHASSIS, MOTHERBOARD, **POWER SUPPLY**

KIT	\$229.00
WITH CPU (8080A)	\$349.00
or with ZPU	\$479.00
assembled with connectors and tested.	\$200.00 ADDITIONAL

Special Discounts For Quantity Orders

\$249.00 \$125.00
\$125.°°
\$819.00
\$1019.00
\$649.00
\$975. 00

\$ 6.95
\$11.95
\$7.95
\$6.45
\$13.95

TO ORDER: CALL or WRITE

(ASK FOR OUR DISCOUNT CATALOG OF OTHER PRODUCTS) VA Residents add 4% Sales Tax

DATA IV, INC. 5706 Barrymore Drive Centreville, Va. 22020 703 (524-9335

AVAILABILITY OF ALL ITEMS LISTED IS WHILE SUPPLY LASTS PRICES & SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE FREIGHT ADDITIONAL

CHECK OR MONEY ORDER ONLY

CIRCLE INQUIRY NO. 68

Short Software Routines such as math packages and I/O diagnostics for all microcomputer configurations.

- Application Software Programs such as Analog To Digital Converter (DAC)—Digital to Analog Converter (DAC) software control programs, Automated membership billing and mailing list update program, Inventory control software, invoice and billing software. Accounts Receivables and Payable software, process control programs, etc. for all microcomputer configurations.
- Software Communications Protocol Programs for such communication protocols as the BSC or Bisync (Binary Synchronous Communications protocol procedures) and the new SDLC (Synchronous Data Link Control communication protocol procedures), etc.

Off-line Software Storage Format Control Programs for cassette, paper tape, and floppy disc software recording formats.

Microcomputer Game Programs

 Add Your Own Program Shopping List Here Send your list to the software editor.

INEXPENSIVE MICROCOMPUTER SOFTWARE

The Microcomputer Software Depository (MSD) will act as repository for source and object code tapes. Programmers wishing to contribute programs to the public domain but who do not want to bother with distribution, may do so by forwarding appropriate documentation including short descriptive write-up and punch paper tape copy of program if possible or cassette copy to MSD. There is no membership fee for access to the public domain paper tapes (PDT) from MSD.

Anyone may obtain copies of these PDT software packages by prepaying a small fee with the order to cover duplication, postage and handling cost. Prices will be listed periodically in INTERFACE AGE. Typical cost for a short program will be approximately \$2.00 (\$2.00/ounce) + tax, postage and handling. As a convenience MSD will also provide punched paper tape copies of vendor supplied software packages (VSP) that will be sold at vendor suggested sale prices. For a current copy of the available software from the Microcomputer Software Depository (MSD) send a check for \$1.00 with a prestamped return envelope to MSD.

Support MSD to build a software library by sending copies of your documented software programs including short description, flow diagrams and punched paper tape source code and object listings if possible or cassette tape copy for low cost distribution to the following address: Microcomputer Software Depository, 2361 E. Foothill Blvd., Pasadena, CA. 91107; (213) 449-0616.

See the new expanded Software Library listing in the April issue.

OCTAL DEBUGGING PROGRAM (ODT-80) PART IV-LLL BASIC

By E. R. Fisher

FOREWARD

This article is the last part of a series of four articles covering the LLL 8080 BASIC Interpreter program released to the public domain by Lawrence Livermore Laboratories. This month we shall cover the description of the Octal Debugging Program ODT-80 and include the complete assembly listing of the ODT-80 program.

INTRODUCTION

ODT-80 is an octal debugging routine for use on the Intel 8080 microprocessor. This routine provides the capability to examine and modify all of the memory that is available to the microcomputer and transfer program control to the created program. ODT-80 makes use of simple keyboard commands from any terminal—such as a teletypewriter—that is attached to the system.

ODT-80 (Octal Debugging Technique) is a program written for the MCS-80 that allows the user to modify a program via a teletypewriter keyboard. The program occupies 400 octal words and must be located in the lowest memory page of the MCS-80 system, since the program uses the RESTART instructions.

ODT has been proved to be an effective aid to debugging on microprocessors. The first version,¹ for the Intel 8080,* has been "front panel" for virtually hundreds of microprocessor applications. The author submits this ODT for the 8080 in hopes that the tradition of soft panels may be perpetuated.

SYSTEM REQUIREMENTS

All addresses of memory locations and contents of memory locations are referred to in octal numbers. A question mark (?) will be typed for any illegal input.

The minimum system requirements for using ODT are as follows:

- MCS-80 computer set
- ODT programmable read only memory (PROM) at memory page ØØØ₈
- 256 word (RAM) at page Ø1Ø₈
- Teletype interface with the following codes: OUT 2—SEND ASCII character IN 2—Input word from TTY

	D_7		Dø		
IN 3—Read Flags	11	111	111	(flag	word)
Sending Done			1		
Word Received_					

UTILITY ROUTINES

The following subroutines are available to the user as utility routines for other programs:

Address	Call	Routine
3Ø7	RST ODT	Restart ODT program. This is useful for error branching in program debugging.
367	RST SEND	Send the ASCII character presently in the "A" register.
315 333 Ø	CAL READ	Wait for a character to be received from the teletype and return with the ASCII character in the "A" register. The "A" and "B" registers are used in this routine.
315 370 Ø	CALL CRLF	Send a carriage return and a line feed to the tele- typewriter. The "A" register is used in this routine.
315 301	CAL OCTALP	Send a space and type in Octal the three digit number in the "A" register.
Ø		a sa marana a na nagasan
		The A, B, and E registers

COMMANDS

(n₈/) —The ASCII Slash (/) character is used to Open the n₈ address and type the contents in octal.

are used in this routine.

- (LF) —The ASCII Line Feed (LF) character is used to close the currently open address, and open the next sequential address. The contents of the open register may be changed by typing the octal number to be input and then typing a (CR).
- (.) —The ASCII Period (.) operator character may be used before the (/) operator to open the address last used.
- (n_8S) —The SET command is used to set the H register to the memory page to be accessed. (EX) 10S ;H = 0108
- (n₈R) —The READ operator is used to start a loader program in memory page No. 2, location ∅.

If this command is preceded by an "nS" command, the n value will be passed to the loader program in the H register.

(n₈G)—The GO routine is used to start a program in memory. The octal number typed before the "G" operator will set the starting address in memory. The "G" operator should be preceded by an "nS" command to select the desired page.

(CTRL-

- C) —The ASCII Control C character is used to command the type out of the top two locations in the stack. (See trap.) Leaves the stack pointer at its initial position -2.
- (CR) —The ASCII Carriage Return (CR) character is used to close the currently open address.

TRAP

The trap feature of ODT works as follows: When the central processor encounters a 3778 as an instruction, the processor decodes this as a restart to location 708 in memory 08. An example of this is when a nonexistent memory is addressed, or when a 3778 is placed in a program for a break point. At this time, ODT stores in the pushdown stack the address of the errant location and all of the registers. The trap indication is a "T" typed out on the teletypewriter. Control is now back in ODT and multiple Control-C's (CTRL-C) typed by the operator will yield, in sets of two (One set for each CTRL-C Typed), the trapped information in the following format:

FDDO	ADDRESS				DECIC	TED			
ERRO	R +1				REGIS	IER			
PAGE									
NO.	LOCATION	Α	F	В	C	D	E	H	L
XXX	XXX	 XXX	XXX,	*XXX	XXX,	XXX	XXX	XXX	XXX

The "F" register is the status flags of the 8080, with the format shown in Fig. 1.

D ₇	D ₆	D ₅	D ₄	D_3	D ₂	D,	D _o	
MSB (SIGN)	ZERO FLAG	Ø	CARRY 1	Ø	EVEN PARITY	1	CARRY 2	

Fig. 1. "F" register format.

A CTRL-C typed at any time will type out the pushdown stack but *not* in the format shown above! The above format is only available immediately after a "T" has been sent by ODT.

If a continuous string of "T" are sent to the TTY without stopping, this is an indication that the stack pointer is pointing at nonexistent memory. It will be necessary to restart ODT.

RESTART/INTERRUPT LOCATIONS

There are five segments of memory reserved in ODT for INTERRUPT or RESTART operation. These locations, shown in Fig. 2, contain jumps to the scratch RAM memory #10, used by ODT. This allows interrupt service to be handled even though memory #0 is preprogrammed to contain ODT.

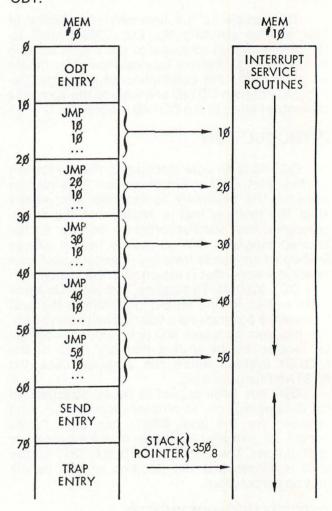


Figure 2. RESTART/INTERRUPT locations.

STACK POINTER

The stack pointer is reset to location 350_8 every time ODT is restarted via location 0 of ROM 0—in other words, whenever a "?" is sent by ODT. ODT and other programs use the stack pointer; therefore, memory locations plus and minus this location are apt to be overwritten. However, the stack pointer moves down in memory (high addresses to low addresses), so normal operation will keep the stack pointer in RAM 10_8 .

EXAMPLE OF TYPICAL DEBUGGING OPERATION

The following example illustrates a typical

debugging operation. It is assumed that a program has been assembled and that the program is to be loaded by a loader in PROM 2.

1. Set the memory field with the S command, and

read the tape with the R command.

1ØS* ;SET MEMORY FIELD TO 1Ø ØR ;START READER ON TTY ? :WHEN TAPE IS READ IN

;WHEN TAPE IS READ IN ODT RESTARTS (startup of ODT depends upon the reader program

in PROM 2)

2. Start the program with the G command.

1ØS ;START PROGRAM AT LOCATION

ØG

TEST PROGRAM; TYPED BY PROGRAM WITH AN ERROR

Change location (30) to correct output. Restart ODT.

? 1ØS

30/327 322) ;CHANGE "W" TO AN "R" ØG

TEST PROGRAM; CORRECTED OUTPUT

EXAMPLE PROGRAM LISTING

					ODT TEST PROGRAM	
					;10-21-74	
000006				SEND EQU		
000370				CRLF EQU	370Q	
					PROGRAM PROPER	
004000					ORG 4000Q	
004000	041	022	010			:SET UP ADDRESS
	176	022	010		MOV A.M	GET ENTRY
004004	376	000		Loor.	CPI 0	, OLI LIVIKI
004004 004006	712	016	010		JZ ND	; IF O END OF LIS
004011	767	010	010		RST SEND	TYPE CHARACTER
004011					INX H	; ITPE CHARACTER
004012		003				
004013	303	003	010		JMP LOOP	;LOOP
004016	315	370	000	ND:	CALL CRLF	;SEND CRLF
004021	166				HLT	
					:	
004022	324			TABLE:	DB 324Q	;T
004023	305				DB 305Q	:E
004024	323				DB 3230	;S
004025					DB 324Q	;T
004026	340				DB 2400	; SPACE
					DB 320Q	;P
004027	327				DB 327Q	;W FOR ERROR
004031					DB 3170	;0
004032	307				DB 3070	;G
004032					DB 3220	;R
					DB 301Q	;A
004034	715				DB 315Q	:M
004035						, 11
004036	ø				DB Ø END	
O PROGRAM	ERRO	RS				
1						
8080 MACR	O ASS	EMBL	ER,	VER 1.1	ERRORS = 0 PAGE 2	

ACKNOWLEDGEMENTS

I wish to acknowledge the work of Jim

004015

PSW

English, who coauthored with me the ODT for the 8008, from which a large part of this program was derived, and Walt Binge and Mike Maples, who helped on the preparation of this paper.

ODT-80 PROGRAM LISTING

8080 MACR	O ASSEMB	LER.	VER I.I	ERRORS = 0 PAGE 1	
					OOT PROGRAM FOR THE MCS-80
					.4-20-74
000000				ORG 0	
000005			TTY EQU		
000006			SND EQU		
000003			FLAG EQ	J 3	
	051 35		11		
000000			ERROR:	LX1 SP.43500	:SET STACK POINTER, PAGE 10.LOC 350
000003	076 27			MV! A.2770	;SEND A ?
000005	303 07			JMP ERR	
000010	303 011	010		JMP 40100	FIRST RESTART LOCATION
000013	000			NOP	
000014	000			NOP	
000015	000			NOP	
000016	000			NOP	
000017	000			NOP	
000020	303 020	010		JMP 40200	
000023	000			NOP	
000024	000			NOP	
000025	000			NOP	
000026	000			NOP	
000027	000			NOP	
000030	303 030	010		JMP 40300	
000033	000	, 010		NOP	
000034	000			NOP	
000034	000				
000035	000			NOP	
				NOP	
000037	000			NOP	
000040	303 040	010		JMP 40400	
000043	000			NOP	
000044	000			NOP	
000045	000			NOP	
000046	000			NOP	
000047	000			NOP	
000050	303 050	010		JMP 4050Q	
000053	000			NOP	
000054	115		PER:	MOV C.L	ROUTINE TO MAKE PERIOD CURRENT LOCATION
000055	303 107	000		JMP NEXTC	
000050	303 344	000	SEND:	JMP SEN	ENTRY POINT TO SEND ROUTINE
000063	315 370	000	GO:	CALL CRLF	SEND A CRLF
000066	151			MOV L.C	SET THE L REG
000067	351				STARTING ADDRESS
000070	343		TRAP:	XTHL	CHANGE ORDER OF STACK H AND L LAST OUT
000071	325			PUSH D	FORTH OUT
000072	305			PUSH B	THIRD OUT
000073	365			PUSH PSH	:SECOND OUT
000074	345			PUSH H	:FIRST OUT IS THE ADR WHENCE WE CAME
000075	076 324			MVI A. 3240 : SEN	
					*
			; T	HE STACK MAY BE DU	MPED BY HITTING A CTRL-C TO GET THE FOLLOWING
			:	SP+1 SPAFBC	DEHL
000077	367		ERR:	RST SND	
000100	315 370	000		CALL CRLF	
000103	257		BEGIN:	XRA A	CLEAR THE AC
000104	056 004		BEG:	MVI D.4	
000106	117		SAV:	MOV C.A	

000074	345				PUSH H	IF INST OUT IS THE ADR WHENCE WE CAME
000075	076	324			MV1 A.3240	:SEND A T
					1	and the second s
				; T	HE STACK MAY	BE DUMPED BY HITTING A CTRL-C TO GET THE FOLLOWING
					SP+1 SP A F	RCDEHI
000077	767			ERR:	RST SND	
000077 00C100	715	770	000	Lines.	CALL CRLF	
000100	315	3/0				
000103	257			BEGIN:	XRA A	CLEAR THE AC
000104	056	004		BEG:	MVI D.4	
000106	117			SAV:	MVI D.4 MOV C.A	
000107	315	333	000	NEXTC:	CALL READ	
000112	170				MOV A R	; IS IT A NUMBER ; 270 MUST BE TERMINATOR OR ILLEGAL DIGIT
000113	726	270			SUI 2700	IS IT A NUMBER
000115	703	270	000		ID TERM	230 MIST OF TERMINATOR OR ILLEGAL RIGHT
000115	302	224	000		JP IERM	1270 HUST BE TERMINATOR OR TELEGAL DIGIT
000150	170				MOV A.B	
000151	326	260			SUI 2600	
000123	372	554	000		JM TERM	:YES
000126	025				DCR D	:>260 MUST BE DIGIT BUMP BUFFER CNT
000127	312	000	000		JZ ERROR	BUFFER OVERFLOW
000132	107				MOV P A	100.00.00.00.00.00.00.00.00.00.00.00.00.
000132	171				HOV A.C	CET DOCKTORE INDUTE
000133	171				HUY A.C	GET PREVIOUS INPUTS
000134	057				HAL	
000135	027				RAL	
000136	027				RAL	:270 MUST BE TERMINATOR OR ILLEGAL DIGIT :YES :>260 MUST BE DIGIT BUMP BUFFER CNT :BUFFER OVERFLOH :GET PREVIOUS INPUTS :IF CARRY NUMBER HAS TOO BIG
000137	332	000	000		JC ERROR	: IF CARRY NUMBER WAS TOO BIG
000142	200				ADD B	
					IMP SAV	
000146	151	100	000	CI ACU.	MOV L.C MOV A.M CALL OCTALP	C CONTAINS ADDRESS
000140	131			SETCOM.	HOW C.C	CET CONTENTS
000147	1 /6			GE I CON:	HUV A.H	GET CONTENTS
000150	315	301	000		CALL OCTALP	
900153	076	240			MVI A.2400	
000155	367				RST SND	
000156	303	103	000		JMP BEGIN	
000161	172			LF:	HOV A.D	
000163	726	004		70.0	CIII L	
000166	713	170	000		17 NIND	LE CHT STILL IN NO INDUT HAS DECEMBED
000164	316	170	000		JZ NINE	; IF CNT STILL 4 NO INPUT HAS RECEIVED ; IF CNT <4 DEPOSIT ONPUT IN MEMORY ; BUMP ADDRESS ; GET HI, PART
000167	161	2.2			HUV H.C	THE CHIEF DEPOSIT ONPUT IN MEMORY
000170	076	215		NINP:	MVI A.2150	
000172	367				RST SND	
000173	U54				INR L	; BUMP ADDRESS
000174	174				HOV A.H	GET HI PART
000175	315	301	nan		CALL OCTALP	TYPE HI ADDRESS
000300	176	50.	000		MOV A L	CET LOU BART
000200	715	701	200		CALL OCTALD	TYPE LOW PART
102000	315	301	000		CALL OCTALP	: TYPE LOW ORDER ADDRESS
000204	303	147	000		JAP GETCON	The section of the section of
000207	315	370	000	CR:	CALL CRLF	; SEND A CRLF
000515	172				MOV A.D	
000213	326	004			SUI 4	:BUMP ADDRESS :GET HI PART :TYPE HI ADDRESS :GET LOW PART :TYPE LOW OFFICE ADDRESS :SEND A CRLF :BUFCNT ** 7 :YES NO INCRU SINCE LAST TERMINATOR :LOAD MEMORY HITH INPUT :ERF :IS IT A LF
000215	312	103	000		JZ BEGIN	YES NO INPUT SINCE LAST TERMINATOR
052000	161				MOV M.C	:LOAD MEMORY HITH INPUT
155000	303	103	000			
000224	170			TERM:	MOV A.R	A-10.
000000	776	212			COI 3130	.16 17 4.16
000223	3/0	eic	000		CPI EIEU	115 11 4 17
755000	316	101	000		JZ LF	
000535	376	215			CPI 2150	: IS IT RETURN
000232 000234 000237 000241 000244 000246 000251	312	207	000		JZ CR	
000237	376	322			CP1 3220	;R
000241	312	000	002		JZ 10000	START READER PROGRAM
000211	776	267	002		CD1 2570	ISTAIL READER THOURAN
000244	3/0	257			CP1 23/4	
000246	312	146	000		JZ SLASH	
000551	376	307			CP1 3070	
					MOV A.B CPI 2120 JZ LF CPI 2150 JZ CR CPI 3220 JZ 10000 CPI 2570 JZ 50000 CPI 2570 JZ 5000 CPI 2560 JZ PER CPI 3070 JZ 500 CPI 2560 JZ PER CPI 2030 JZ CTRLC	;G
000256	376	256			CP1 2560	:PERIOD
000260	312	054	000		JZ PER	
000263	376	203			CP1 203Q	
000265	312	357	nnn		JZ CTRLC	CONTROL C
000270	376	727	230		CP1 3230	.6
000270	302	253	000		INT CODOR	COUND AN ERROR
000272	305	000	000		JNZ EHRUH	FOUND AN ERROR
000275	141			SETX:	HUY H.C	SAME HI ADDRESS
000276	303	100	000	000000000000	JMP ERR+1	99596 St. 1940.000.
000301	006	004		OCTALP:	MVI B.4	SET CNTR
000303	007				RLC	CONTROL C SOUND AN ERROR SAME HI ADDRESS SET CHIR

computer

Your Mail Order Computer Shop...

IMSAI 8080 kit with 22 slots (limited quantity) \$5	99.00
TDL Z-80 ZPU (the one with full software available now) 2	42.00
Edge Connectors and guides for IMSAI each	4.25
Lage Connections and gardes for inform for the connection of the c	40.00
Seals 8k RAM kit with 500 ns chips	225.00
	260.00
North Star complete Micro-Disk System kit 5	99.00



WETAKE MASTER CHARGE OR BANKAMERICARD For phone and mail orders... (Add 4% of TOTAL ORDER for service charge)



C 000001 D 000002 ERROR 000000 H 000004 NEXTC 000107 PSH 000006 SEN1 000346 SND 000006 ITY 000002

TERMS: Shipping charges - \$10. per CPU or large units, \$1.50 per kit, \$2. minimum per order.

Provided stock is available, we will ship immediately for payment by

cashiers check or money order.

Allow 3 weeks for personal checks to clear. New York State residents add appropriate sales tax.
PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

For the best prices available on:

IMSAI . TDL . NORTH STAR . POLYMORPHIC NATIONAL MULTIPLEX . SEALS ELECTRONICS

(315) 637-6208

WRITE: P.O. Box 71 • Fayetteville, N.Y. 13066

CIRCLE INQUIRY NO. 77

TAKE ADVANTAGE OF US!

DON'T DUMP YOUR MONEY INTO THE MAILBOX-THEN SIT AROUND AND WAIT!!

DON'T BUY FROM WANDERING MERCHANTS WHO WON'T BE THERE WHEN YOU NEED THEM!!

A COMPUTER MART IS A PLACE WHERE THEY CARE ABOUT YOU — AND YOUR COMPUTER EQUIPMENT.

WE SELL THE BEST LINES, AT REASONABLE PRICES. THAT'S HOW WE MAKE OUR LIVING.

WE HELP YOU GET YOUR SYSTEM UP AND RUNNING. WE WILL BE HERE TOMORROW AND THE NEXT DAY!

LEASING ARRANGEMENTS NOW AVAILABLE.

THE COMPUTER MART

NEW YORK

314 Fifth Avenue, New York, N.Y. 10001 (212) 279-1048 Between 32nd and 31st Two blocks from the **Empire State Building**

LONG ISLAND

2072 Front Street East Meadow, L.I., New York, 11554 (516) 794-0510 Near Hempstead Turnpike

Closed Monday

IMSAI, PROCESSOR TECHNOLOGY, SOUTHWEST TECHNICAL PRODUCTS, OSI, SEALS ELECTRONICS, DIGITAL GROUP, APPLE COMPUTERS, TARBELL, OLIVER, CROMEMCO, TDL, CONTINENTAL SPECIALITIES, VECTOR, GBC VIDEO MONITORS, BOOKS, MAGAZINES, CHIPS, SOCKETS, CONNECTORS. . . AND ALL THAT GOOD STUFF.

CIRCLE INQUIRY NO. 78

000	304	007				RLC								
000	305	137				MOV	E.A		:5/	AVE AC				
000	306	076	240			HVI	A.2400		;58	IND A SE	PACE			
000	310	367				RST	SND							
000	311	173				HOV	A.E		; GE	T THE	C			
000	312	346	003			ANI	3		: M/	SK				
000	314	005			DECR:	DCR	В			CR				
000	315	310				RZ	-			ONE ?				
		306	260				2600		:NO					
		367					SND	SEN		CHARAAC	TER			
		173					A.E			T AC				
		007				RLC	~		.00					
		007				RLC								
		007				RLC								
		137					E.A			VE AC				
			007											
		346				ANI			:MA	15K				
			314	000			DECR							
		333	003		READ:		LAG		; RC	DUT INE T	O READ	ONE CH	AR FRO	M TTY
		037				RAR								
000			333	000			READ							
000		333	200			IN								
000		107					B.A							
000	1344	353	005		SEN:	OUT	TTY		:RC	T BALTUC	O OUTPU	T AN A	SCII C	HAR
000	1346	333	003		SEN1:	IN	LAG							
000	350	037				RAR								
000	351	037				RAR								
000	352	170				MOV	A.B			RESTORE	A REG	FROM R	EAD	
000	353	330				RC				DONE?				
000	354	303	346	000		JMP	SENI			NO				
000	357	341			CTRLC:	POP	н							
000	360	174				MOV	A.H							
000	361	315	301	000		CALL	OCTAL	P						
		175				MOV								
							GETCON							
			150	000				• 1			-			
		076	215		CRLF:		0215.A		, SE	ND A CR	LF			
		367				RST								
		076		-			A.2120							
000	1375	303	344	000			SEN		;RE	TURN VI	A SEND			
-			-			END								
NO PR	OGRAM	ERRO	RS											
				9	SYMBOL TAR	BLE								
• 01														
A	0000	07	E	1	000000		BEG	000104		BEGIN	000103			
C	0000	01	C	R	000207		CRLF	000370		CTRLC	000357			
D	0000	50	0	ECR	000314		E	000003		ERR	000077			
ERROR	0000	00	F	LAG	000003		GETCO	000147		GO	000063			
н	0000	04	L		000005		LF	000161		M	000006			
NEXTO	1000	07	N	INP	000170		OCTAL	000301		PER	000054			
PSW	0000	06	F	EAD	000333		SAV	000106		SEN	000344			
SENI	0003			END	000060		SETX	000275		SLASH	000146			
SND	0000			P	000006		TERM	455000		TRAP	000070			
TTV	0000						0.00000							

Development Software

• 8080 DIS-ASSEMBLER

Two Pass; Converts machine language code to assembly code. Uncovers ASCII tables. Generates up to 12K labels. Prints out symbol table. Address offset print output.

Development Software

8080 DIS-ASSEMBLER

- Two Pass
- · Converts machine language code to assembly code
- Uncovers ASCII tables
- · Generates up to 12K labels
- · Prints out symbol table
- · Address offset print output
- Object code in Intel's punched paper tape format @ 30.00 + 1.50 Calif. sales tax + 2.00 postage. Manual @ 5.00 + .30 Calif. sales tax + 1.50 postage.

***** EPS-1 SOFTWARE DEVELOPMENT **OPERATING SYSTEM**

Powerful 8080 Assembler-Monitor-Text

\$30.00 + 1.80 Calif. sales tax + 1.50 postage and handling (includes manual).

DEALER INQUIRIES INVITED

Call or Write

Microcomputer Software Depository

2631 E. Foothill Boulevard Pasadena, California 91107

(213) 449-0616

AMI's Re-entrant self-relative Subroutine ROM: (RSRSRS) = (RS)³

Edited by Robert A. Stevens

FOREWORD

This software article is the last of a fourpart series on the EVK 6800 microcomputer hardware, firmware and supporting software. This month's article covers the EVK re-entrant selfrelative subroutine program library software resident in ROM.

INTRODUCTION

The cost of microprocessor software development involves many small items: the cost of assembly time, storage time, transmission time, loading time, design, development, documentation and debug. The cost of many of these items continues to accumulate even though a subroutine library exists for common functions, in particular the time and cost of transmission, loading and ROM pattern generation.

The purpose of Re-entrant Self-Relative Subroutine ROMs (RS)³ is to give the user a hardware subroutine package which exists in the breadboard design from the beginning. The programs are documented, debugged and constitute some of the most commonly performed subroutines that assembly language programmers generate.

CONCEPTS

The (RS)³ uses a number of concepts to allow flexibility in the user environment. The first concept is self-relative programming. This simply means that the program will function correctly regardless of where it is located in memory. The user will need to know where it is located so he can reference it. However, this actual location will only have to be recorded once. The self-relative program uses relative address instructions for program control and the index and stack pointer instructions for data manipulation.

The stack is used for temporary storage of data to prevent (RS)³ from being tied to fixed addresses. This allows the program to be re-entrant; i.e. the program can be called at different times without completing the previous call. This means that the same routine can be called by the interrupt processor as well as by the program which was interrupted. The concept of re-entrant code is not to be confused with recursive code; even through recur-

sive coding could have been used in the subroutine package, it is not.

The subroutine calling mechanism uses the SWI instruction followed by a single byte index for the particular subroutine invoked. This was chosen because the SWI from an internal programming viewpoint is the most convenient and the safest. It is safe because an error in a ROM can be corrected by replacing the subroutine ROM without altering any other user ROM. If direct addresses to subroutine code exist in the user's domain, his ROMs would change if the location of the routine in the (RS)³ changed.

IMPLEMENTATION

The user places the base address of the (RS)³ into the SWI vector address. Each SWI instruction requires an index byte to follow the SWI instruction where the index indicates the function to be executed. After the function is performed, the user program will continue with the instruction following the index byte. In essence, a whole new set of instructions have been created for the user which are two bytes long.

To make the entry easier, a macro call can be provided which will assemble the correct index byte when the function name is used. A set of EQU assembler commands associates the name and the index byte value.

Examp	le:

MUL8 MUL1 DIV8 DIV1	EQU	10 11 12 13
FUN	MACRO SWI	INDEX
	BYTE MEND	INDEX
	FUN	MUL8

MARCH 1977

Each (RS)3 ROM will have the ability to interrogate the index byte and vector to the appropriate subroutine if it is included in the ROM. If the index extends the number of subroutines included on the ROM, the number is subtracted from the temporary index value and the next (RS)3 ROM is automatically branched to. This allows the user to select any of several subroutine sets, where each set of subroutines is represented by a separate ROM. The selected ROMs are concatenated together into a contiguous region of the user's memory space, and are automatically linked together by the index value. Thus the actual value of the index byte for any particular subroutine is the sum of the total number of subroutines in the physically previous (RS)3 ROMs plus the offset in its own ROM. It must be noted that address assignments for (RS)³ ROMs must be made beginning at 1K boundary addresses.

The 2K X 8 ROM provided with the PROTO prototyping system includes a set of (RS)3 subroutines with a slightly different linkage from the standard (RS)3 form, although the calling sequence is the same. In particular, the provision for additional subroutines in the form of other (RS)3 ROMs is limited to a total of 127 subroutines. The first additional (RS)3 ROM address must be placed in RAM location FFF4 (which can be set via the Set Memory command or modified by an initialization code in a user program). Also, since it is incorporated into a larger program, the whole of which nearly fills the 2K bytes of the ROM, the (RS)3 part of the ROM does not start on an even page boundary, making it awkward for isolated use. However, the 24 subroutines included in this ROM are available to user program calls with the SWI calling sequence, as described.

(RS)3 SUBROUTINES

The ROM Subroutine Library (RS)³ operates on a single SWI (3F) command and a second byte of offset giving the S6800 an additional set of two-byte instructions.

Each of the subroutines in the ROM are described, giving the index for the call, a mnemonic subroutine name, and a descriptive title. A brief description of the subroutine operation is also given.

SUBROUTINE INDEX NUMBER

MNEMONIC
NAME
FUNCTIONAL TITLE
AND DESCRIPTION
OU PUSHALL Push All Registers

Five bytes are pushed onto the stack, containing, respectively, the Condition

Codes, the B and A accumulators, and the Index Register. No registers are altered (except the Stack Pointer, which is decremented by 5).

01 POPALL Pop (= Pull) All Registers

Five bytes are pulled from the stack into the Condition Codes, the B and A accumulators, and the Index Register, respectively. The Stack Pointer is incremented by 5.

02 TXAB Transfer Index Register to A and B

The most significant eight bits of the Index Register are copied to the A accumulator, and the least significant eight bits are copied to the B accumulator.

03 TABX Transfer A and B to Index

Accumulator A is copied to the most significant byte position of the Index Register, and accumulator B is copied to the least significant byte position of the Index Register.

04 XABX Exchange A and B with Index

The contents of the Index Register and the two accumulators are exchanged, A with the most significant byte of X, B with the least significant byte.

05 PUSHX Push Index Register

The contents of the Index Register is pushed onto the stack. The Stack Pointer is decremented by two.

06 PULLX Pop (= Pull) Index Register from stack

Two bytes are pulled from the stack into the Index Register, and the Stack Pointer is incremented by two.

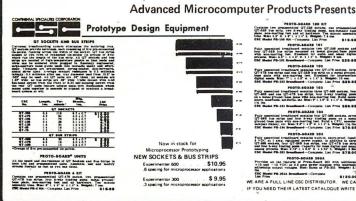
07 ADDXAB Add Index to A and B

Add the contents of the Index Register to the two accumulators, as a 16-bit sum, leaving the result in the two accumulators. The most significant byte is assumed to be in accumulator A. The condition codes are set according to the result.

Condition

Codes: H = carry from bit 11 to bit 12 of sum N = bit 15 of sum Z = 1 if sum is zero;

else = 0







CES Black PA-SI Browthond-Coasians. Let Your \$15.00 pt. PATCH AND THE PATCH ASSESSED ASSESSE

★ MICROPROCESSOR PRODUCTS

MPUTER BUILD, YOUR OW! COMPLETE COMPUTER SYSTE

AMI EVK 99 6800 BASED MICROCOMPUTER

They now have 85 systems. The Performance, versatility and cost Photo is of expanded EVK 99 Board Photo of

expanded EVK 99 NOW \$133.00

EVK 99

2. UNIVERSAL KLUGE BOARD \$98.00
Completely companies to the EVK system. This board allows the user to add any additional parts the desires. If this \$400 holes, holds \$4.16 pm ICS or others to \$2.4.6.6.97 or greater centers. \$2.50 pm, 1.20 pm fact cable, 1.25 pm f85232.

3. 16K BYTE RAM BOARD \$77.95

4. 6 SLOT, MOTHER BOARD \$29.95 5. EXTENDER BOARD \$46.50

se with back plane above in card cage configuration boards are now in development including cassette I/O and others. If you want information drop us a line.

, ,	AMI S6800	24.95	S6820			11.00	2102/9102	1.89
	AM2901	29.95	\$6810	1		6.25	9111/2111	4.75
A I	GI CP1600	69.95	\$6850			10.95	9101/2101	5.25
- 1	Z80	69.95	\$2350			12.95	9112/2112	2.95
N	6502	29.95	S1883			5.90	7489	1.88
	AM2902PC	\$ 3.95	\$6834	1		22.95	4104/4804	12.95
	AM2905PC	10.95	\$6800	Prings arents	long Marinal	15.00	4402A	12.95
M	AM2906PC	11.95	\$6800	Hardware	Married	15.00	4200	12.95
	AM2907PC	10.75		Tory Barre	Tanaper hapen	22.95	9131APC	14.95
- 1	AM2909PC	24.95		On 6834	Prom	175.00	9141APC	14.95
- 1	AM2911PC	18.95	8212	\$ 4.75	AM2533	7.50	9050/TMS4050	
- 1	AM2918	6.75	8224	6.25	AM2401	16.50	9060/TMS4060	12.95
- 1	AM29720PC	7.95	8216	4.95	AM1402	6.95	P3101	3.25
- 1	AM29721PC	7.95	8226	5.95	AM1403	5.95	5101	11.95
- 1	AY-51013A	5.50	8228	9.90	AM 1404	6.95	1702A	10 90
- 1	AM2812	14.95	9551	19.95	MM500H	2.25	2708	68.00°
- 1	AM2841	12 00	9555	19.95	MM5016F		5204	23.50
- 1	AM3341	9.95			AM3347	6.40		

TV GAME KITS SPECIAL ONLY
Only (1) GLAY38500 1 TV Game Chip \$29.95 BUY 10 OF THE FOLLOWING AND YOUR PRICE IS. . . TV KIT NO.1 ON Includes AY38500 LTV GameChip \$34 PC Board for video composite output \$34 plus instructions. Add \$5.95 for 2MHz crystal TV KIT NO. 2 AMD 8080A......\$19.95 AMD 9111......4.10 AMD 9112.....2.30 ONLY . \$34.95

RF MODULATOR MODULE

¥ NEW PRODUCTS

To convert your video composite to RF try
UM 1021 Channel 3/4 VHF Modulator DC Switchable
VSWR = 2 max
VCC = 6.5 volts

DC Coupled modulation input with positive transfer characteristic.
Designed for use with TV Games.

SPECIALS										
Ī	75452	10/2.50	S							
	8T26B	2/5.00								
	74LS138	1.49								
	8097	.99								
	74166	.80								
	74161	.49								
	741HC	10/2.50								
	MH0026CN	3.95								
	1488	1.29								
	1489	1.29								

Includes AY38500 1 TV GameChip.
PC Board, Switches, pols, speaker,
crystal, XFMR, Bridge and all parts
required for video composite. Works
super with terminal. Includes instructions.

ation drop us a line.		1489	1.29		
ICMARKET I	7	AC	E	*	

					*	LIP	NEAF						
LM10	8	3 50	LM320K 5	2 1.45	LM	381N	1.79		414N	1.75	7532		3.50
LMIC		2.50	LM320K 1			382N	1.79		1458CN	.65	SG45		2.40
LM30		80	LM320K 1			555CN	.58		496N	.95	SG45		2.40
LM30		45	LM320T 5	1.75		556CN	1.30		111N	1.95	SG35		8.95 6.95
LM30		45	LM320T 5			567CN	1.45		1901N 1065N	69	RC41		6.95
LM30		1 25	LM3201 8	1.75		565N	1.95		900N	.55		58CN	.89
LM30		1 20	LM320T 1			565H	1.95	LM3		1.10		56CN	.99
LM30		1 25	LM320T 11	9.95		703CN	45	LM7		2.25			2.30
LM30		95	LM324M	1.65		709H	40		524N	1.75		31CN	.99
LM30		35	LM339N	1.55		710N	70	LM7	525N	1.90	RC41		1.90
LM30		35	LM340K 5	1.95		711N	.39		534N	2.20		58CN	.99
LM30		1.00	LM340K 8	1.95		711H	39	LM7	535N	-1.25	RC41	51CN	5.50
LM30		1.00	LM340K 1			723N	.55			100	THE STATE OF		
LM30	911	1.10	LM340K 1		LM	723H	.55			CMC)S		
LM30	9K	1 25	LM340K 1				3.25						
LM31		1 15	LM340K 2				1.00	CD4000	.25	CD4026	1.95	CD40	7.
LM31		1 15	LM351CN	65		33CH	1.45	CD4001	25	CD4027		CD40	
LM31		90	LM370N	1.65			1.29	CD4002	25	CD4028		CD40	
LM31		49	LM370H	3.25		41CH	.35	CD4006	1.75	CD4029		CD40	
LM31		1.95	LM373N LM377N	4.00		41CD	.39 .49	CD4007	25	CD4030	.60	CD45	
LM31		150	LM377N	1.39		47H	75	CD4008	1.95	CD4033	2.49	CD45	
LM31		1 30	LM380CN	1.05		47N	75	CD4009	48	CD4034	4.95	CD45	16
LM32		145	E-111300C14			48H	39	CD4010	.48	CD4035	1.79	CD45	
Cm32	UK 5	1.40			LM		39	CD4011	.28	CD4040	2.10	CD45	
No. of Lot	-	-	-	The second		-	THE OWNER OF THE OWNER,	CD4012 CD4013	60	CD4042 CD4043	1.45	CD45	
			7400	TTI				CD4013	1.95	CD4043	1.45	CD45	
		*	7400	IIL				CD4014	1.95	CD4049	1.95	CD45	
								CD4016	59	CD4050	61	CD45	
7400N	.18	7445N	.99	74122N	.44	74185N	\$2.10	CD4017	1.25	CD4051	2.25	CD45	
7401N	.18	7446N	.99	74123N	.80	74190N	\$1.30	CD4018	2.39	CD4066	1.20	CD45	
7402N	.18	7447N	.99	74125N	.79	74191N	\$1.30	CD4019	1.95	CD4068	35	CD45	
7403N	.18	7448N	.99	74126N	.79	74192N	\$1.10	CD4020	1.35	CD4069	35	CD45	
7404N	.19	7450N	.26	74132N	.70	74193N	\$1.10	CD4021	1.85	CD4070	.99	CD45	82
7405N	.20	7451N	.26	74141N	.88	74194N	.96	CD4023	29	CD4071	.35	CD45	85
7406N	25	7453N	.26	74145N	.70	74195N	.95	CD4024	1.29	CD4072	.35	Also	
7407N	21	7454N 7470N	45	74147N 74148N	\$1.59	74196N 74197N	.95	CD4025	29	CD4073	.35	5101	\$1
7408N 7409N	21	7472N	30	74150N	\$1.15	74196N	\$1.45		100	The state of the	20 TO 10 TO 10		-
7410N	.21	7473N	30	74151N	.98	74199N	\$1.85	DI E	CEN	SEMI	CONI	TOLICE	0.
7411N	21	7474N	30	74153N	98	74251N	\$1.45	PLES	SET	SEIVII	CONI	ו טטכ	U
7412N	.21	7475N	.69	74154N	\$1.15	74279N	\$1.10						
7413N	.45	7476N	.42	74156N	.96	8093N	.49	RAL	NO C	MMO	LINIC	:ATI	NC
7414N	.60	7480N	.70	74156N	.95	8094N	.49	IIIAL	0.0				
7416N	.35	7482N	.95	74157N	.95	8095N	.99		SL 16100		SL 162 SL 163	4C 2.75 OC 1.95	
7417N	.35	7483N	.95	74160N	.99	8096N	.99		SL 16110		SL 164		
7420N	.19	7485N	.89	74161N	.99	8097N	.99		SL 16130		SL 164		
7421N	36	7486N	\$1.88	74162N 74163N	.99	8098N 75150N	.99		SL 16200		SL 164		
7423N	35	7489N	60	74164N	.99	75150N		1	SL 16210		SL 165	OC 5.75	
7425N	35	7490N 7491N	70	74165N	.99	75451N	\$1.10		SL 16220	2.95	SL 165		
7426N 7427N	36	7491N	.59	74166N	\$1.10	75452N	.59		SL 16230	2.95	SL 168	OC 3.75	
7427N	28	7492N	.79	74170N	\$4.20	75453N		Application	m Manual I	or \$1,600 Circ	erts		1.9
7430N	21	7494N	.79	74172N		75454N	.59			or Catalogue			3.9
7432N	31	7496N	.79	74173N	\$1.40	75491N							
7433N	30	7496N	.79	74174N	\$1.25	75492N			D	IVIDE	:RS		
7437N	35	7497N	\$3.75	74175N	\$1.25	75493N		SP86008	6.95	SP86208	12.50	SP86408	6.2
7438N	35	741006		74176N	.79	75494N		SP8601B	4.25	SP8621B	8.50	PS86418	7.5
7440N	.21	741048		74177N	.79			SP86028	16.00	SP86228	6.50	SP86428	12.5
7441N	\$1.06	74106A		74180N	.79			SP86038	14.50	SP86308	20.00	SP86438	20.0
7442N	.69	741075		74181N	\$2.75			SP8604B	8.25	SP86318	12.00	SP86468	6.5
7443N	.69	741096		74182N	.79			SP8607B	17.00	SP86328	10.00	SP8647B	8.0
7444N		741218		74184N	\$2.10			SP86138	17.50	SP8634B	35.00	SP86508	25.0
100 0	IECE	CHILV	TAVE	וח שחו	CCOLL	NIT.		SP86148	18 00	CP96 26.0	27.50	SPR651R	18 5

74191N	\$1.30	CD4019	1.95	CD4068		CD4556	
74192N	\$1.10	CD4020	1.35	CD4069		CD4581	4
74193N	\$1.10	CD4021	1.85	CD4070		CD4582	1.
74194N	.96	CD4023	29	CD4071		CD4585	
74195N	.96	CD4024	1.29	CD4072	.35	Also	
74196N	.95	CD4025	29	CD4073	35	5101	\$11
74197N	.95						
74196N	\$1.45						
74199N	\$1.85	DIES	CEV	CEMI	CON	DUCTO	יםר
74251N	\$1.45	FLLS	DL I	SLIMI	COIN	DUCI	JIAN
74279N	\$1.10	100	AND DE				
8093N	49	BAL	IO C	OMM	LIMI	CATIO	N
8094N	49	MAL	100				
8095N	.99		SL 1610C		SL 16		
8096N	.99		SL 1611C		SL 16		
8097N	.99		SL 1612C		SL 16		
BOSEN	.99		SL 1613C		SL 16		
75150N	\$1.70		SL 1620C		SL 16		
75450N	\$1.10		SL 1621C		SL 16		
75451N	.59		SL 1622C		SL 16		
75452N	.59		SL1623C	2.95	SL 16	80C 3.75	
75453N	.59	Application	Manual to	- \$1,600 Circ	with		1.95
75454N	59	Pleasey Ser	niconductor	Catalogue			3.95
75491N	.70						
75492N	.70		D	IVIDE	-RS		
75492N							
	\$1.10	SP86008	6.95	SP86208	12.50	SP86408	6.20
75494N	\$1.10	SP8601B	4.25	SP8621B	8.50	PS86418	7.50

1.95 2.40 2.55 2.95 2.95 2.95 2.95 DIVIDERS \$P86208 12.50 \$P86218 8.50 \$P86228 6.50 \$P86308 20.00 \$P86318 12.00 \$P86318 12.00 \$P86328 10.00 \$P86348 35.00 \$P86388 22.50 \$P86388 22.50 \$P86378 *18.00 6.20 7.50 12.50 20.00 6.50 8.00 25.00 18.50 * NEW PRODUCTS

F4702 Baud Rate Gen.

8214 Priority Int.

780 CPU

780 CPU

From lasis David Guzeman's formerly of Intel - Complete 6 Volume Programmed learning course "Microcomputer Design is a Snap" only \$99.50 Microcomputer Application Handbook only \$7.95 lasis 8080 Microprocessor System in a book complete instructional and Microcomputer Send for complete details on all lasis Products.

ALTAIR /IMSAI COMPATIBLE 8K MEMORY

SK MEMORY
Our new brain board comes complete with 21L02-1 memory chips (500ns) and sockets All address control and data out lines fully buffered.
\$198.00 COMPLETE If you desire 91L02APC - Please add \$9.95

6800 STARTER SET Only 68 Bucks \$68.00 You Get (11 6800 8 bit CPU (11 6820 PIA (12 6850 ACIA (16) 2102 RAMs

.35 .35 .35 .35 .35 1.95 2.45 2.56 2.70 1.50 1.95 2.25 1.75 1.75 1.75 4.95 2.45

8080A STARTER SET \$80.00 111 8080A 8 bit CPU 111 8212 I O Port 111 8224 Clock (11 8228 System Cont 1241 2102 RAM's

All shipments first class or UPS in U.S. or add 5% for shipping and handling. Minimum order \$10.00 California Residents add 6% tax. Foreign add 8%.

ADVANCED

* MCROCOMPUTER
P. O. BOX 17329
IRVINE, CALIFORNIA 92713
PHONE (714) 968 3655



D-SUBMIN CONNECTORS RS-23225 Pin Male Part No. DB25P . . . RS-23225 Pin Female Part No. DB25S . . . RS-232 Plastic Hood for above . . . 1.000 MHz 2.000 MHz 2.097 162MH 4.000 MHz 5.000 MHz 6.000 MHz 10.000 MHz



	CRYSTALS		rocessors Timebas les Precision Cryst		
ncy	Case	Price	Frequency	Case	Pri
MHz	HC6/HC33	4.95	13.000 MHz	HC18	4.9
MHz	HC6/HC33	5.85	14.31818 MHz	HC18	4.9
62MHz	HC6	6.95	18.000 MHz	HC18	4.9
ИHz	HC18	4.95	20.000 MHz	HC18	4.9
MHz	HC18	4.95	32.000 MHz	HC18	4.9
MHz	HC18	4.95	100Kc	HC13	12.9
MHz	HC18	4.95	3579.45 Kc	HC18	4.9
			2.4576 MHz		5.9



2708 PRIME

M2000 - 155 9-inch display module *Add \$10.00 Shipping

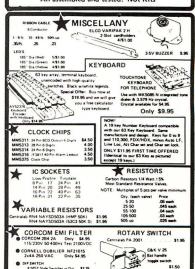


Build Your Own MONITOR Now in Stock - NEW M3000 - 100 12-inch display module

ONLY \$49.95

\$229.00

All assembled and tested. Not Kits



100 PIECES MIX TAKE 10% DISCOUNT 1000 PIECES MIX TAKE 15% DISCOUNT

SOFT	WARE SECT	TION	MICROCOMPUTER DEVELOPMENT SOFTWARE					
00	ADDADY	V = 1 if two's complement overflow C = carry out of bit 15 of sum	0E	SUBBX	Subtract B from Index Registe Subtract the contents of the B ac- cumulator from the Index Register, leaving the difference in the Index			
08	ADDABX	Add A and B to Index Register Add the contents of the two accum- ulators to the Index Register, leaving the 16-bit sum in the Index Register.			Register. The Condition Codes are set according to the result. Condition Codes: (Same as SUBXAB)			
		Accumulator A is assumed to be more significant than accumulator B. The condition codes are set according to the result.	0F	P2HEX	Print Byte in Hex The byte pointed to be the address in the Index Register is converted to hexadecimal notation in ASCII, and			
		Condition H = carry from bit 11 to Codes: bit 12 of sum N = bit 15 of sum Z = 1 if sum is zero, = 0 otherwise			output to the ACIA located as follows Memory locations FFF6—FFF7 contain an address of a pair of bytes (in direct pointer) which in turn contain the address of the ACIA Status			
		V = 1 if two's comple- ment overflow C = carry out of bit 15			register. FFF7 iL FFF6 iH			
09	ADDAX	of sum Add A to Index Register			i+1 aL i aH			
		Add the A accumulator to the contents of the Index Register, and return the sum to the Index Register. The			a + 1 ACIA Data a ACIA Status			
		Condition Codes are set according to the result. Condition			Each byte of the output is stored into the ACIA Data Register after bit 1 of the Status Register is true. The Control Register of the ACIA is			
DA	ADDBX	Codes: (Same as ADDABX) Add B to Index Register Add the contents of the B accumu-			not altered, and the Data Register is not read by this routine. The Index Register is incremented past the byte			
		lator to the Index Register, and leave the sum in the Index Register. The Condition Codes are set according to the result. Condition Codes: (Same as ADDABX)	10	P4HEX	which is output. Print Address in Hex The two bytes in memory pointed to by the Index Register are converted to four ASCII digits and output to the ACIA located at the address pointed.			
0B	SUBXAB	Subtract Index from A, B Subtract the contents of the Index Register from accumulators A and B			to by the pointer pointed to by the byte pair at FFF6—FFF7 (see P2HEX) The Index Register is incremented by two.			
		as a 16-bit difference. The Condition Codes are set according to the result. Condition	11	PRINTA	Print the Byte in A The byte in accumulator A is output			
		Codes: H = undefined N = bit 14 of difference Z = 1 if result is zero, = 0 otherwise			to the ACIA, the address of whose address is the locations FFF6—FFF7 No registers are altered except the ACIA Data Register.			
		V = 1 if two's complement overflow C = borrow into bit 15	12	PMSG	Print Message String A message string, the first byte of			
0C	SUBABX	of difference Subtract A and B from Index Register			which is pointed to by the Index Register, is output to the ACIA, the address of whose address is in lo- cations FFF6—FFF7. The string is			
		Subtract the contents of the A and B accumulators from the Index Register,			terminated by an ASCII EXT (= hex 04), and the Index Register is left pointing to that byte on return.			
		leaving the difference in the Index. The Condition Codes are set according to the result. Condition	13	VALAN	Validate AlphaNumeric The character pointed to by the index Register is analyzed, and the Carry flag is set if it is a letter or digit;			
0D	SUBAX	Codes: (Same as SUBXAB) Subtract A from Index Register Subtract the contents of the A accumulator from the contents of the Index Register and return the differ-			if it is not a hexadecimal digit, the Overflow flag is set. Other than the condition codes, no registers are altered.			
		ence to the Index Register. The Condition Codes are set according to the result.			Exit:Condition Codes: H = undefined N = undefined			
		Condition Codes: (Same as SUBXAB)			Z= 0 V= 0 if character in range 0—9, A—F; else = 1			

C = 1 if character in range 0—9, A—Z; else = 0

14 INPUTA Input ACIA byte to A

One byte is input from the ACIA, the address of whose address is at location FFF6—FFF7, and this byte is returned to accumulator A. The ACIA is not written to, and except for the A accumulator, no registers are changed. (RS)³ samples bit 0 of the status register of the ACIA, and when it goes to one, reads the Data Register. The input byte has bit 7 removed (set to zero).

15 CONHB

Convert Hex String to Binary

A string of characters in memory beginning at the address in the Index Register is scanned for valid Hexadecimal digits; when one is found, it and all immediately following hex digits are converted to a binary number, which is left in the A and B accumulators (A is more significant). When this routine is called, the maximum length of the string is in the B accumulator. On exit, the Carry flag is set to one if the conversion resulted in a valid binary number, and the Index Register is left pointing to the next character in the string, or if the string is exhausted before finding any hex digits, to the last character of the string. Max string length in B is (< 128).

Condition

Codes:

H = undefined
N = undefined
Z = undefined
V = undefined
C = 1 if valid number;
= 0 if not

16 INDEX

Multiply A X B and Add to Index The contents of the A accumulator is multiplied by the contents of the B accumulator, and the product is added to the Index Register. The Condition Codes are set according to the Result.

Condition

Codes: (Same as ADDABX)

17 MUL8

Multiply A Times B

Multiply the contents of the A accumulator times the content of the B accumulator, and leave the product in both accumulators as a 16-bit number, with the most significant part in A. This is an unsigned multiply, and if either or both of the factors is negative (two's complement signed) the product will not be a true signed product of the signed factors, as may be seen in this formula:

(-n)X(m) = (256-n)Xm = 256m + (-nm) The condition codes are nonetheless set according to the result.

Condition

Codes:

H = undefined N = bit 15 of product V = 0 Z = 1 if product is zero; otherwise = D

RS3 ASSEMBLY PROGRAM LISTING

```
1 HSHSH U1/09//6 9:28 HSHSH -- REENTHANT SELF HELATIVE SUBROUTINE ROM
                                                                 TITLE RSRSH -- REENTHANT SELF RELATIVE SUBHUUTINE RUM
                                                                   (HS)**3 SUBMUUTIVE HOM FOR USE WITH PROTO
                                                                    VEHSIUN 2.0 01/05//6
                                                                     CUPYRIGHT 1976 BY AMERICAN MICHUSYSTEMS INC.
                                                                   ITEMS EQU 24 NUMBER OF ROUTIVES
LALLING SERVENCE
                                                                                                                                                x+1 INDEX
x+2 NEXT INSTRUCTION
                                                                                        ISEC
URG $58E
LUCAL
DEF RSRSR
                                                                             ENINY IS VIA LOW UNDER ADDRESS OF HUM 
<<ADDRESS IS PLACED IN SAI VECTOR ADDRESS
                                                                                   EGU A
                                                                             DUUBLE IT FOR VECTOR ADDRESS INDEX
               U58E 50
                                                                        TSX SP INTO X
HESTURE STATE OF INTERRUPT AT TIME OF CALL
                                                                                        LOX 5,X
                                                                                                                                                  X HAS INDEX ADDRESS
                058F EE 05
                 05C1 4F
05C2 E6 00
05C4 58
05C5 49
                                                                                                                                                   INDEX INTO B
                                                                             A.B HAS TAD TIMES INDEX
                                                                               VECTOR OF SUBROUTINE ADDRESSES IS AT 512
                                                                             FRUM HERE TO VECTUR IS 512 - WHERE WE ARE
                0566 80 00
                0508 50
                                                                            TSX
A,D mill HAVE INDEX •2 + LOCATION(:A)
ADD m 1,x
AUC A 0,x
ADD VECTUR OFFSET
                 05C9 EB 01
05CB A9 00
                                                                                        ADD B #(LUCV&H'00FF) LOW ORDER EIGHT BITS
ADC A #(LUCV/H'100) HIGH ORDER EIGHT BITS
                 05CD CB 24
05CF 89 01
                                                                             A.B. NUW HAS ADDRESS OF SUBROUTINE ADDRESS
                                                                                       NUM ANS ADDRESS OF SUBMOUTINE ADDRESS OF SUB
               05DB 30
05DC A7 00
05DE E7 01
05E0 A6 02
05E2 06
05E3 EE 00
                                                                                                                                                  STURE OLD STATE INTO CO
                                                                             INS
INS
JUMP TO SUBROUTINE
JSR 0,x
                05E5 31
05E6 31
                                                                             NUMMAL EXIT FROM SUBROUTINE
INCREMENT RETURN ADDRESS
INC
INC 6.X
BNE **4
INC 5.X
                                                                            EXII
                05F0 3B
                                                                             STACK ELEMENTS ARE STACK PUINTER +2 SINCE JSH
                                         0002 A UC
0003 A UB
0004 A UX
0005 A UX
0006 A UXL
0007 A URL
                                                                                                                                                CC RELATIVE TO SP

B RELATIVE TO SP

A RELATIVE TO SP

XM RELATIVE TO SP

XL RELATIVE TO SP

RELATIVE TO SP

RELATIVE TO SP
                                                                            PUSH ALL UNTO STACK -- REGISTERS CORRECT ON EXIT
                                         0000 A SRH
0001 A SRL
                                                                                                                                                SYSTEM RETURN H RELATIVE TO SP
SYSTEM RETURN L RELATIVE TO SP
                                                                             PUSH ALL REGISTERS UNTO STACK--REGISTERS UNMODIFIED

    CUMMENT STACK SP +1 +2 +3 +4 +5 +6 +7 +8 +9
    SPH SPL CC B A XH XL UPL UPH
    RESULT STACK BEFORE RETUNN TO MAIN EXT
    RESULT STACK BEFORE RETUNN TO MAIN EXT
    RESULT STACK BEFORE RETUNN TO MAIN EXT
    RESULT STACK BEFORE RETUNN TO MAIN EXT

                                                                         HALL EUU .
                                                                             MUVE STACK DOWN
                                                                                       LUA B #9
15x
LUA A 5,x
31A A 0,x
1Nx
UEC B
BNE :S
                                                                                                                                                  THE BYTES TO MOVE
                                                                             HELJPY "PUSHED" REGISTERS
                                                                                       LUA D #5
15x
LUA A UC.x
S1A A UC+7.X
INX
UEC B
                                                                                                                                                  DEFSET BY 7
                                                                            EXIT TO MAIN
               U60C 34
                                                                                       215
                                                                             USER STALK IS
                                                                         PUP ALL REGISTERS
                                                                         LUCAL
LL EQU *
TSX
CURRENT STACK
SHM SPL CC
RESULT STACK
```

PHINT 2/4 HEX CHARS FHOM MEM(UX,UX+1)

UN IS INCHEMENTED UPON DUTPUT I.E. UX = UX+2.

PAINT 2 HEX CHARS FRUM MEM(UX)
0/21 1 PAMÉX EUU
15x
US LOX UXH,4 USERS
01 USM PHEX PRINT

. PHINT 2 HEX CHARS FRUM MEM(X)

0041 54

1LS12 CUU .

ntu :a

ntu :a

ntu = an'f-i

:a S1A + UC.4

H15

			LULAL		
0721	0721 00 04 95 GB	1 PHEX	LUA A	O.x ASCIIA	GET THE CHAR CUNVERT THE RIGHT NIBBLE AND RESULT IN
0720	50 46 UU		PSH A	0, 4	SAVE IT
072E	80 AF		BSH	PUTAX	CONVERT THE LEFT NIMBLE INTO A
1735	32		BSH A	PUTA	HECOVER SAVED THEN FALL INTO PINCA
		INC	HEMENI I	HE JSEHS X	IN THE STACK
1135	0/35	1 PINCX	EQU TSX		SP IS +2 SINCE THU HSR DUNN IN CALLS
730 738 734	90 09 90 09		DINC	: KTS	SP IS +2 SINCE THU HSP DUNN IN CALLS INC MEADRY X LOW DVER FLUW MEANS INC HIGH PART
750	34	: #15	HIS	UX4+2,X	EXIT
angraph .	0/50		EUU	+AH % USE≺	5 4
73E	30 Ab U4		TSX LOA A LUCAL	UA,X	GET CHAR
		. PH1	T CHAR	IN DESIGNA	TED REG
		· kud	MACHIL		
		HEADY BIT BEU PUL STA HIS	5× 1.×	NUT READY	
		. PRI	MENU IT CHAN I	I (4 A	
0740	FE FFF6	A PUTAX	LDX	H'FFF6	GET INDIRECT ADDRESS OF ACIA GET ACTUAL ADDRESS OF ACIA INTO X
0745	30 Ab 00	PUIA + +:HEAU1	POT PSH A	A	
0748 074A	85 UZ 27 FA	:	BEU A	#02 :HEADY	READY ?
0/4E 0/4D 0/4F	32 47 01 59	:	SIA A	1,4	RESTURE CHAR PRINT CHAR
		:	LUCAL		
		. LUM	ERI A P	нији нех то	ASCII LEFT/RIGHT NIBBLE
0750	675u	I ASCIIL	LSH A		A HAS CHAR TO HE CONVERTED
0753	44		LSR A LSR A		
1/50	84 UF 84 50	ASCIIK	AUD A	#H'0F #H'50 #H'59	CLEAR LEFT PART
0750 0754 0750	81 34 24 UZ 88 U/		DLS ADD A	:RTS	YES DUNE NU THEN A TO F
175E	34	: +15	HTS	.k maturita	IN MY X AND TERMINATED MY ETX
		•	LULAL	SE POLATED	IN ST. X AND TERMINATED BY ETX
0/5F 0/60	50 EE U5	I PMESS	TSX LDX	Ux-1,x	GET USERS x
100	81 U4 27 Up		CMP 4	O.x BEIX	GET CHAR IS IT TERMINATOR DUNK
0/05 0/04 0/0L	80 C4 20 F1		05H 05H	PUTAX PIVCX PMESS	PHINT A INC USERS X LOUP TILL DONE
17st	34	* 11x	*15	неоч	EDDF TIEE DONE
			S ADDRES	S UF CHAR	TO TO ME TESTED EMIC
	U/6+	. VALA	EUU LUCAL	IF THUE	
0770 0770	50 EE U5 80 U5		LUA	75 3 4.7 x	GET CHAR ADDRESS TEST MEM(x)=ALPHANUMERIC
,,,,	85 05	• St 1 t			ENT CARRY (AND DIRER FLAGS:)
1774	01	SLAHRI	IPA		
1175	50 2/ 02 34	SETUS	514 4 815	UC.x	
		. 351 (4447 11	mt M(x) 15	ALPMA YUMEN IC
	0/14		Lau.	.x 01011	2CHH4 40MEH1C
0110	01 41		LUA A	# * A	GET THE CHAR
7/13	20 of 21.54 25 12		CAP #	:1034 212 :V3136	TOO SMALE FOR ALPHA .IS IT NUMERIC
105	24 10		0 4 A	#125+'5 :#15	SET V 1F >F 3011 1F V01 HEX (C=1) CHMVEHT LETTER TJ HEX 31H1P JVERHITS FHUR HEX 01011
1/54 1/50	94 OF	:UN	AND A	#17	STRIP JVERDITS FROM MEX DIGIT SET C FOR VALLO AZN
1/50	81 30 20 04	:1.0.4	LIP A	# · 0	VUMENIC TESTING VOT NUMERIC
141	21 34		200 H	: NOTUK #19 :UK	HESEL CARAL FOR AUT AVA
745	0C 03	: .0104	SEV		MESEL CARMY FOR WIT AVO SEL V FOR WOL HEX ELIMEN
798	20 98		HOA	PIVCX	EXTRA BRA TO MEACH PINCX
		• 1NPU1	A: OT ACIA	DATA INTO	A REG
079A	FE FFFO	I INPUIA	EGU LDX	H'FFF6	GET ACIA INDIRECT ADDRESS GET ACIA ADDRESS
074F	Ab 00	InAlT	LDX	0.x	GET ACIA ADDRESS ACIA STATUS CARRY:=HDRF
0741	47 24 Fo		ASH A	: * 4 ! !	NO INPUT. LOOP.
07A4	A6 01 84 7F		LDA A	1 . × #H'7F	ACIA DATA STRIP PARITY PUT RESULT ONTO STACK
U/A6 U/A9 U/A6	50 47 04 59		STA A	UA.X	PUT HESULT ONTO STACK
		. CUNHE	CUNVER	HEX TO B	INANY: ARACTERS STARTING AT X
		. LUI	IN ING PUR	WE NUMBER GNORE MSB'S	TO A.B. IF NUMBER HAS MURE THAN
		INPU			ST CHAR TO BE SCANNED.
		DUTP			ULT ID NUMBER IS FOUND ST CHAR SCANNED
		:	X P	UINTS TO LA	ST CHAH SCANNED

22				***				****		******	****	*********	
24			0/4	C I CUN		CAL							
25	OTAC	30				X	-						
26	OTAD	Eb	v3		L	A B	UB	, x		GET	MAX C	Dun1	
27	UTAF	OF				R	UA					R'S A.B REGS	
85	0751	6F	03			H	UB						
54													
30				* L	OUP WHI	L M	UT A	LPHAN	UME	IC AND	CUUNT	> 1	
51				•									
2.5	0783	30		:10									
5 5	0784 0786	EE				×		H, X		GET	CHAH	ADDRESS	
55	U788		09			S		MUNG		15 4	EMIXI	ALPHANUMERIC!	
56	0784	54	0.4		131	CE		JUNU		163.	CUUNT	SCANNING	
57	0788		04			Ł		NDCNT				AUSTED	
38	U75D	80			D.			INCA		LVC	USER	9 1	
19	U7BF	20	Fe		ы.	AS	: L						
10													
1				* £1	NU LUUP								
5													
3				* CI	DUNT EXP	AUS	TED	MITH	NO	SUCCESS			
4				. 11	CARRY MA	SH	ESET	BY A	LPNL	M)			
15				•									
0	07C1	50	81	:EN	ULNI BE	A.	SC	ARRY		HESE	T USE	R C AND RETURN	
7				*									
8				* n	milt Ht	AN	U CO	UNT >	0 5	HIFT ME	M(X)	INTO UA, UB	
0				1	EGIN OU		, One						
1	0763	50		: + 0			LUUP						
5	0764	Et	115	., 0	LI LI		118	H, X					
5	0756	HD					A	PNUM		Chut	MEMI	X) TO HEX	
4	0768	29				15		36000		INVA	LIDC	HAR	
5	UTCA	37				H H		30000		SAVE	COUN	T	
00	U7CB	Co	04		L	A D	=4			LUOP	COUN	Ī	
7													
0				* 5	miri Lti	TU	A.UB						
9													
U		30				X							
1	O7CE	08	04	: 5L	UUF A	iL	UB.	+1 . x		+1 1	0 004	P. FOR PUSH	
2	0/10	69	05		н	JL.	114	+1.×					
3	5010	DA											
4	0705	2 E	14			.1	:5	4664					
5													
0	0105	AA	04			A A		+1 . x		'UR'	IN N	EN CHAH	
1	0/07		04		S	A A	Ur	+1 . x					
00	0707	5.5				JL II				HEIH	ltvt	COU-I	
0	UTUE	54				H		1 VE x		INC	USEH	x	
1		25				1		2000		HE PE			
2	0.00		-		WU UUIL			JUND		HEPE	41		
5	07DF	UD			31		UF.				D NUM		
4	U/EU	50	92		01		SC	ARRY		SET	U NUM	C AND HETURN	
5							50			116.1	USER	C AND REIDRA	
0				A 161	IN-HEA (HAH	FOU	NO.	1F 0	HAH = 1.	-7. 1	HIS IS VUT A VALID	
7				. 11	A NU 45t	ri .	UTH	EHAIS	£ . C	HAR 15	A OF	IMITER AND	
6				. 141	JABER 13	VA	LID.				0		
9							300						
0	0762	07		:1400	11 1000					1066	LE CA	HRY BIT	
1	U/ES	40	-6		1	LA							
5	0/64	50	10		17.6		SE	TUS		SETU	P USE	H STATUS & RETURN	
3					200	74							
*	SYMBUL	TAB	Lt:		E	U							
											0.00		
AU	DAH U	000		AUUADX U				2690		AUDHX			
AD	DAAH U	14	1	AUUL U	746 1			U7/9		ASCIIL	0610	1	
	O ATU			Jariz o	7 ML 1			0798		LUCY	0124		
	CVV U			MPYB U	one I			VOCO		NITEMS			
		151		PAHEX U		PHE		1210		PINCX			
PM	ESS 0	151	i	PUPALL U	DUU 1	PH	NIA	U750	i	PULX	UOSE		
PU	SHAL U	of I	I	PUSX V	047 1	PU	I.A.	U745	1		0740		
	RSR U		i	SCAHHY U	114 1	St	Tus	U775	1	SRH	0000	A.	
SR		001		5140 U	1 050								
	BAX 0	500	I	SUBBA U	oLu I	SU	DAXO	UB9E	1	SVECTU	UDEC	1.	
	dx 0	520	1	16512 U	000 1	Ix	48	0628	1	UA	0004	A	
UB		105	A			UR	4	0007	4.	UHL	0008	Δ	
				UAL U	000 A	VAL	An	076F	1	x 4 b x	0650	I	
UX	SUM =	C/08								SUBABX SVECTU UA UPL XABX			
UX													
ECM													
EC.	H UF D	SEL	=	0 (0)	100)								
UX ECH	H OF D	SEC	=	>>> (0)	(99)								

4K Low Power Static RAM Board Kit \$79.95

FULL HIGH IMPEDENCE BUFFERING • 4.5" x 6" WITH STD 44 PIN GOLD-PLATED EDGE CONNECTOR • MILITARY QUALITY
PC BOARD WITH PLATED THROUGH HOLES • 450 NS. LOW
POWER 2102 RAMS • ON-BOARD ADDRESS DECODING
INCLUDES FULL DOCUMENTATION

6800 OEM Prototype Sets

PROTOTYPE BOARD (With Sockets) See September issue, p. 72 for details. 42.50

LOW COST 6800 STARTER SET

Includes board, sockets, 6800 CPU, 6810 RAM, 6820 PIA, address decoder, documentation for minimum system.

84.95

NEW 1K RAMS at Surplus Prices 2102-1 1.45

	organization	ACCOSS IIMO	Price
RAM	1Kx1	450 ns 2102	1.45
	256x1	45 ns low pwr	3.90
PROMS	512x8	100 ns	16.00
	256x4	80 ns	3.00
E PROMS	256x8	1 ms	10.00
7 segment LE	D displays .3" high.	Very bright 1 tube (25)	30.00
Octal and deci	mal decoder with 4	bit latch	
and constant (current drivers for a	bove displays	1.75

DISCOUNTS AVAILABLE AT OEM QUANTITIES

KATHRYN ATWOOD . Calif. Residents add 6 sales tax **ENTERPRISES** P.O. BOX 5203

ORANGE, CA 92667

 For total orders less than \$25.00 add \$1.25 shipping and handling Estimated shipping time 7 days ARO

GRAPHICS — THE EASY WAY

By Marvin Mallon

The relatively recent introduction of the Video Terminal Interface board by Poly Morphic Systems (Goleta, CA) is big news for the home computerist. Not only can it generate full upper and lower case alphanumeric characters (with the Greek alphabet thrown in for good measure), but it uniquely offers a set of 64 graphic symbols as well. Others were on the scene first with video cards having a 16 line, 64 character capability or with a colorful graphics library, but no one offered both on the same board prior to Poly's contribution.

It's all made possible by a good deal of state-ofthe art circuitry combined with a unique 128 set Character Generator (MCM6571A by Motorola). An unusual arrangement of having 1K of RAM on-board permits you to stuff bytes into these addresses only to have them jump up on the screen on the next scan. Sixteen (lines) times 64 (characters) equals 1024. Every spot on your modified TV has its counterpart in memory on the VTI.

Setting aside all other matters, let's zero in on

the graphics generation. As Figure 1. indicates, each one of these 1024 "cells" can contain in addi tion to the alpha-numerics set any one of 64 different "semaphore" displays. These are simply the combinations of ways that six "sub-cells" in a 2 by 3 matrix of white and black can be arranged. Each of the 64 characters in a line is now further subdivided in half and each of the 16 lines on your screen is subsequently trisected for a new arrangement of 6144 discrete "dots". Even though this still doesn't add up to the fine resolution of your TV picture or your favorite X-Y plotter, you can still accomplish a great deal, as I'll further explain. MITS 8K BASIC permits you to address any spot in memory directly and either see what's there ("PEEK") or put something there ("POKE"). Even the 1K RAM on board the VTI can be reached by this means. Therein lies the secret of creating unusual graphic programs in BASIC. Caution: POKE and PEEK can't be used above the 32K level and consequently your VTI board should not be addressed any higher than 7C00_{HEX}.

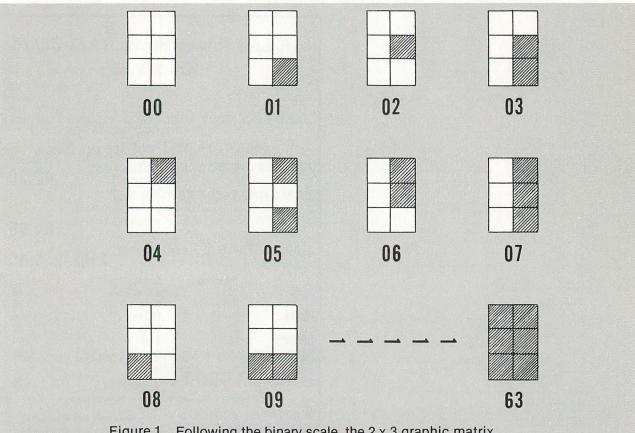


Figure 1. Following the binary scale, the 2 x 3 graphic matrix progresses from all "white" to all "black" in semaphore style.

MICROPROCESSOR COMPONENTS

CPU'S

8008-1	8 Bit CPU	\$17.95
(18 Pin)	(PMOS)	
8080A	8 Bit CPU	24.95
(40 Pin)	(2us) (NMOS)	

8080 SUPPORT DEVICES

8212		\$ 4.25
8214	I/O Port Priority	8.95
17.77	Interupt Control	
8216	Bi-Directional	4.25
8224	Bus Driver Clock	8.00
	Generator	0.00
8255	Programmable	
	Peripheral Interf	ace

ROM'S

74S387	1024 Bit	\$ 2.50
	Programmable	
MM5230	2048 Bit	1.95
DM8796	4096 Bit	10.00

PROM'S

82S23	32 x 8 Open \$ 3.00
1702 A	Collector (Schottky) 2048 Bit 5.00 (512 x 4) (1us) Erasable and
1702AL	Electrically Reprogrammable 2048 Bit 7.00 (512 x 4) (LO-PWR) (1us) Erasable
2708	and Electrically Reprogrammable 8192 Bit 40.00 (1024 x 8) Erasable and
8223	Electrically Reprogrammable 32 x 8 Open 3.50 Collector

SHIFT REGISTER'S

MM506N	Dual .	\$.89
	100 Static	
P-2405	1024	4.95
	Dynamic	
N2518B	Hex 32 Bit	3.95
N2533V	1024 Static	3.95
MM5013N	1024 Bit	2.00
	Accumulato	r
	Dynamic	
MM5017N	Dual	2.00
	500/512	
	Dynamic	
MM5058	1024 x 1	2.50
	Static	
TMS3002LR	Dual 50	3.00
	Static	
TMS3132NC	Dual 144	2.00
	Static	

CALCULATOR CHIPS

MM5736	6 Digit Cal.	\$1.25
CT5001	12 Digit Cal.	1.75
Wit	h Specifications	

RAM'S

21L02	1024 x 1 Static	\$1.58
1101	256 x 1 Static	1.00
1103	1024 x 1	1.50
1103	Dynamic	1.50
2101	256 x 1	3.00
2101	Static (1us)	0.00
2102	1024 x 1	1.50
	Static (1us)	
2102-1	1024 x 1	1.65
	Static (500NS)	
2107B	4096 x 1	6.50
	Dynamic (200N:	S)
2107B-4	4096 x 1	5.00
	Dynamic (270N)	
2107B-6	4096 x 1	4.50
	Dynamic (350N)	
3107	256 x 1	2.95
04074	Static (80NS)	0.50
3107A	256 x 1	3.50
4050NL	Static (60NS) 4096 x 1	4.00
4030NL	Dynamic (300N)	
5261	1024 x 1	3.00
0201	Dynamic (400N)	
5262	2048 x 1	3.00
0202	Dynamic (365N	
5280	4096 x 1	4.00
	Dynamic (200N)	S)
7489	16 x 4 Static	1.50
8599	16 x 4 Static	1.50

MISC. OTHER COMPONENTS

N8T20	Bi-Direc-	
N8T26	tional One Sho Quad Bus	3.25
110120	Driver/Receive	
N8T97	Tri-State	1.45
	Hex Buffer	
1488	RS232 Quad	1.25
	Line Driver	
1489	RS232 Quad	1.25
	Line Receiver	
D3207A	Quad	2.50
	Bi-Polor to	
	MOS Level	
	Shifter/Driver	
C-3404	6 Bit Latch	3.95
	12NS Output	
	Delay	
P-3408A	Hex Sense	6.75
	Amplifier W/La	atch
P-4201	Clock	4.95
	Generator	
MM-5320	T.V. Camera	6.00
	Sync. Generat	or
MM-5369	Oscillator	2.00
	Pre-scaler	
MC-6850L	Asynchronous	
DM8130N	Ten Bit	2.25
	Comparator	
DM8131N	6 Bit	2.00
	Comparator	

DISPLAY LED'S

Туре	Polarity	HGT.	Price
MAN-4	Common Cathode	.187	\$.75
ILD-74	Logic Drive	(8 Pin)	
	Opto-Isolator	(8 Pin)	1.00
DL-707	Common Anode	.300	1.25
DL-747	Common Anode (Jumbo)	.60	2.00
TIL-113	Opto Coupler	(6 Pin)	2.00
TIL-302	Common Anode		
	(LORR DEC)	.27	1.00

TTL PRODUCT

			-		
7400	.14	7441	.85	7496 .65	74160 .86
7401	.20	7442	.44	7497 2.00	74161 .62
7402	.20	7443	1.20	74100 1.25	74162 1.00
7403	.20	7445	.89	74107 .76	74163 .76
7404	.20	7446	.87	74109 .35	74164 .80
7405	.20	7447	.69	74110 .50	74165 .90
7406	.39	7448	.81	74116 2.00	74166 1.00
7407	.39	7450	.20	74120 1.25	74167 3.00
7408	.20	7451	.20	74121 .34	74170 2.00
7409	.24	7453	.20	74122 .39	74172 9.72
7410	.20	7454	.20	74123 .50	74173 1.25
7411	.20	7460	.20	74125 .45	74174 .85
7412	.24	7470	.20	74126 .45	74175 .75
7413	.35	7472	.23	74128 .65	74176 .85
7414	.70	7473	.26	74132 .95	74177 .85
7416	.33	7474	.29	74136 .50	74180 .75
7417	.33	7475	.39	74141 .80	74181 2.00
7420	.20	7476	.31	74142 4.00	74182 .90
7422	.50	7479	1.50	74143 3.00	74184 1.65
7423	.28	7480	.69	74144 4.00	74185 1.30
7425	.24	7482	.72	74145 .70	74186 5.00
7426	.24	7483	.75	74147 2.50	74190 1.00
7427	.24	7485	.90	74148 1.75	74191 .65
7428	.40	7486	.25	74150 1.00	74192 .85
7429	.40	7488	3.50	74151 .70	74193 .85
7430	.20	7489	1.50	74153 .70	74194 1.20
7432	.28	7490	.39	74154 .90	74195 .55
7433	.34	7491	.65	74155 .70	74196 .80
7437	.28	7492	.39	74156 .90	74198 1.50
7438	.28	7493	.39	74157 .70	74199 1.75
7439	.36	7494	.70	74158 1.75	74200 3.50
7440	.20	7495	.50	74159 2.25	74279 1.75

LINEAR

LM308N(8)	Micro Power Op Amp	\$.75
LM311N(8)	Hi-Performance Volt. Comp.	.95
LM318N(8)	Precision Hi-Speed Op Amp	1.95
LM324N	Quad 741 Op Amp	1.00
LM339N	Quad Comparator	.75
LM380N	2 Watt Audio Power Amp	.60
LM381N	Low Noise Power Amp	1.95
NE555V	Timer	.60
NE566V	Function Generator	2.00
NE567V	Tone Generator	2.00
NE723CN	Voltage Regulator	.50
NE739N	Dual Hi-Perf. Op Amp	1.00
NE741CH	Compensated Op Amp	.45
NE741CN	Compensated Op Amp	.35
NE1458CN	Dual Comp Op Amp	.65
NE3900N	Quad Amp	.45



JADE Co



ELECTRONICS DISTRIBUTION

NEW LOCATION

5351 W. 144th ST., LAWNDALE, CA 90260

Add \$1.00 for shipping plus \$.85 if COD California Residents add 6% Sales Tax \$20 minimum on BofA & M.C. Orders from Foreign countries add appropriate postage Phone (213) 679-3313

Retail Store Opens February 21, 1977 Hrs. 9-7 MON.-FRI.; 9-5 SAT.; 12-5 SUN. As an example of how this all works, let's examine a simple BASIC program written for a system containing a Poly VTI board addressed as 7C00:

10 A = 31744: B = 63

20 FOR X = 0 TO 1023

30 POKE A + X, B

40 NEXT X

Line 10 assigns A (for address) the value of 31744. That is the decimal equivalent of 7C00_{HEX}. POKE commands are issued in decimal form, hence this conversion is necessary. Line 10 also assigns B (for black) the value of 63. On the Poly semaphore scale, 63 *is* black. Line 20 to 40 constitute a FORNEXT loop that will POKE the black graphic cell into each of the 1024 locations in ascending order across the screen. So what does this program accomplish? Quite simply, it erases the whole screen preliminary to creating a new display. I use this brief subroutine frequently in my graphics program for just that purpose. Note that the program creates variable assignments for the POKE statement. It plays faster that way. POKE 31744 +

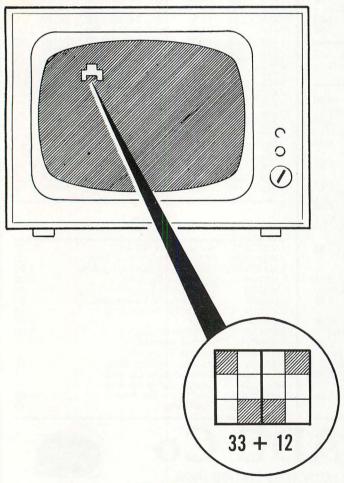
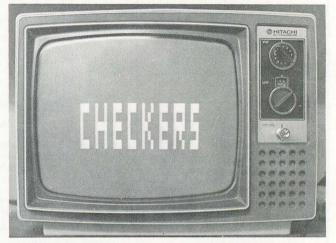


Figure 2.

Nearly any design can be created by merging graphic matrices in combination. The example above shows a "33" side-by-side with a "12". Chess pieces, jumbo words, even animated "characters" can be produced in this fashion.

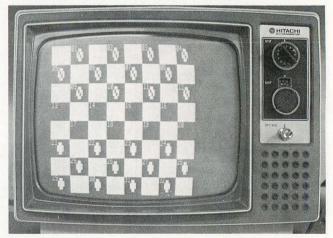
X 63 takes twice as long to perform because BASIC has to convert real numbers to their floating point equivalency before execution.

Figure 2. illustrates the means by which various designs can be constructed by placing combinations of graphic matrices adjacent to each other. It is advisable to make a grid chart and sketch in the patterns you wish to create. It is then a simple task to break this down to a series of graphic "rectangles" at specific addresses. Duplicating this combination of numbers in your BASIC program should produce the desired results.



In Figure 3. you can see that jumbo words can be created just as easily as any other pattern. Here it is used as a "title" on my Checkers program. I also make use of this technique for messages as illustrated in Figure 5.

Figure 4. demonstrates the combination of graph-

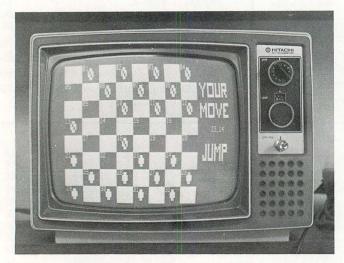


ics and numerics. Each Checker square is numbered with a conventional pair of numerals and serves to assist the player in calling his moves.

Figure 5. is a photo of my 12" Hitachi in the middle of a game of Checkers. Note that the checkers are square. "Round" is not achievable with the limited resolution of the VTI but regardless the display seems presentable. The "hole" in the upper set of checkers denotes the blacks rather than the reds.

My program is incomplete in that the algorithms

DIODES/ZENERS		SOCKETS/BRIDGES	TRANSISTORS, LEDS, etc.		
1N914 100v 1N4004 400v 1N4005 600v 1N4007 1000v 1N4148 75v 1N753A 6.2v 1N758A 10v 1N759A 12v 1N4733 5.1v 1N5243 13v 1N5244B 14v 1N5245B 15v	10mA .05 1A .08 1A .08 1A .15 10mA .03 z .25 z .25 z .25 z .25 z .25 z .25 z .25 z .25	8-pin pcb .25 ww .45 14-pin pcb .25 ww .40 16-pin pcb .25 ww .40 18-pin pcb .25 ww .75 22-pin pcb .45 24-pin pcb .35 ww 1.25 28-pin pcb .35 ww 1.45 40-pin pcb .50 ww 1.95 Molex pins .01 To-3 Sockets .25 2 Amp Bridge 100-prv 1.20 25 Amp Bridge 200-prv 2.50	2N2222 NPN 2N2907 PNP 2N3740 PNP 2N3906 PNP 2N3055 NPN T1P125 PNP LED Green, Red, Clear	.10 .15 1A 60v .25 .10 15A 60v .50 Darlington .35 .15 igh com-anode 1.95	
с моs		– T T L	7 <u>-</u>		
4000 .20 4001 .20 4002 .25 4004 4.95 4006 1.20 4007 .40 4008 1.20 4009 .25 4010 .45 4011 .20 4012 .20 4013 .40 4014 1.10 4015 .95 4016 .35 4017 1.10 4018 1.10 4019 .70 4020 .85 4021 1.35 4022 1.15 4023 .25 4024 .75 4025 .35 4026 1.95 4027 .50 4028 .95 4030 .45 4031 1.25 4040 1.35 4041 .69 4042 .95 4043 1.25 4044 .95 4045 1.50	7400	7476 .20 7480 .65 7481 .99 7483 1.00 7485 1.05 7486 .40 7489 2.50 7490 .55 7491 1.15 7492 .95 7493 .45 7494 1.25 7495 .85 7496 .95 74100 1.85 74101 .45 74121 .40 74122 .55 74123 .55 74124 .40 74125 .45 74128 .45 74132 1.35 74141 1.30 74151 .95 74153 .95 74154 .75 74155 1.15 74156 1.15 74167 1.25 74168 1.35 74169 1.25 74176 1.25 74180 .85 74181 <td>74193</td> <td>74S04 .45 74S05 .45 74S08 .45 74S08 .45 74S10 .45 74S11 .45 74S20 .50 74S40 .30 74S50 .35 74S51 .45 74S64 .30 74S74 .50 74S112 1.50 74S112 1.50 74S113 .45 74S140 .75 74S151A .45 74S153 .45 74S158 .45 74S158 .45 74S194 1.50 74S257 (8123) .25 74LS00 .45 74LS01 .45 74LS02 .45 74LS04 .55 74LS08 .45 74LS09 .45 74LS09 .45 74LS11 .45 74LS11 .45 74LS20 .50 74LS21 .25 74LS20 .50 74LS21 .25 74LS22 .25 74LS32 .55 74LS32 .55 74LS37 .40 74LS40 .55 74LS40 .55 74LS42 1.75 74LS40 .55 74LS42 1.75 74LS90 1.30 74LS90 1.30 74LS917 .95 74LS93 1.00 74LS107 .95 74LS107 .95 74LS153 1.20 74LS153 1.20 74LS153 1.20 74LS164 1.90 74LS367 .85 74LS368 .70</td>	74193	74S04 .45 74S05 .45 74S08 .45 74S08 .45 74S10 .45 74S11 .45 74S20 .50 74S40 .30 74S50 .35 74S51 .45 74S64 .30 74S74 .50 74S112 1.50 74S112 1.50 74S113 .45 74S140 .75 74S151A .45 74S153 .45 74S158 .45 74S158 .45 74S194 1.50 74S257 (8123) .25 74LS00 .45 74LS01 .45 74LS02 .45 74LS04 .55 74LS08 .45 74LS09 .45 74LS09 .45 74LS11 .45 74LS11 .45 74LS20 .50 74LS21 .25 74LS20 .50 74LS21 .25 74LS22 .25 74LS32 .55 74LS32 .55 74LS37 .40 74LS40 .55 74LS40 .55 74LS42 1.75 74LS40 .55 74LS42 1.75 74LS90 1.30 74LS90 1.30 74LS917 .95 74LS93 1.00 74LS107 .95 74LS107 .95 74LS153 1.20 74LS153 1.20 74LS153 1.20 74LS164 1.90 74LS367 .85 74LS368 .70	
9000 SERIES		LINEARS, REGU			
9309 9322 1.	00	mont Mesa Blvd. • San Diego, CA 92 All orders shipped prepaid Open accounts invited Discounts available at OEM Quanti California Residents add 6% Sales	2111 • (714) 278-4394 nimum orders accepted ities	LM723 .45 LM725 1.95 LM739 1.50 LM741 8-14 .25 LM747 1.10 LM1307 1.25 LM1458 .95 LM3900 .65 LM75451 .65 NE556 1.10 NE565 .95 NE566 1.75 NE567 1.35 SN72720 .35 SN72820 .35	



for computer calculated moves as well as the tests for legal moves remain to be written. The program at this point occupies what's left of 12K of memory and adequately demonstrates the graphics portion. I invite you to duplicate my efforts up to this point by running the program listed at the end of this article. The REMARKS should clarify the specific subroutines that perform the tasks of creating the checkerboard, moving the checkers, forming the messages, etc. You may find the algorithms adaptable to graphics programs of your own. Good luck!

```
OK
LIST
```

```
10 REM - CHECKERS FOR 64 CHARACTER VIDEO AT FC
20 REM - ***COPYRIGHTED BY M.MALLON, OCTOBER, 1976***
22 CLEAR O
25 V=31744: BL=63
 30 REM - ***CLEAR SCREEN***
30 REM - ***CLEAR SCREEN***
50 FOR X=0 TO 1023;POKE V+X,BL:NEXT
100 REM - ***PAINT TITLE***
110 FOR X=1 TO 87:READ D:POKE V+D,0:NEXT
140 DATA 396,397,398,401,404,407,408,409,412,413,414,417,420
150 DATA 423,424,425,428,429,430,431,434,435,436
160 DATA 460,465,468,471,476,481,483,487,492,495,498
170 DATA 524,529,530,531,532,535,536,537,540,545,546
180 DATA 551,552,553,556,557,558,559,562,563,564
190 DATA 588,593,596,599,604,609,611,615,620,622,628
200 DATA 652,653,654,657,660,663,664,665,668,669,670
 210 DATA 673,676,679,680,681,684,687,690,691,692
220 REM - ***CLEAR SCREEN***
 230 FOR X=0 TO 1023:POKE V+X,63:NEXT
300 REM - ***RULES***
        PRINTTAB(7);
330 PRINT "LETS PLAY CHECKERS! YOU AGAINST THE COMPUTER."
 340 PRINTTAB(8);
350 PRINT "YOU ARE WHITE(AT THE BOTTOM OF THE SCREEN)."
360 PRINT TAB(21);
370 PRINT "BLACK GOES FIRST."
400 PRINTTAB(7);
410 PRINT "MAKE YOUR MOVES BY TYPING THE SQUARE YOU OCCUPY"
420 PRINTTAB(7);
430 PRINT "FOLLOWED BY THE SQUARE NUMBER YOU WISH TO GO TO."
440 PRINTTABET);
450 PRINT "SEPARATE THESE NUMBERS WITH A COMMA. GOOD LUCK!"
455 REM - ***HOLD SCREEN***
460 FOR X=1 TO 400:NEXT
465 REM - ***CLEAR SCREEN***
470 FOR X=0 TO 1023:POKE U+X,BL:NEXT
 500 REM - ***PAINT CHECKERBOARD***
 510 DIM L(64)
 520 FOR X=0 TO 7:Z(X)=3+X*128:NEXT
530 FOR Y=0 TO 7:FOR X=1TO 8
540 L(X+Y*8)=Z(Y)+(X-1)*6
540 L(X+Y*8)=Z(Y)+(X-1)*6
550 NEXT X:NEXT Y
560 FOR A=1 TO 7 STEP 2
570 FOR X=A TO 64 STEP 16
580 FOR B= 0 TO 5
590 FOR T=0 TO 64 STEP 64
600 POKE V+L(X)+B+T,0
610 NEXT T:NEXT B:NEXT X:NEXT A
620 FOR A=10 TO 16 STEP 2
620 FOR A=10 TO 16 STEP 2
630 FOR X=A TO 64 STEP 16
 640 FOR B=0 TO 5
650 FOR T=0 TO 64 STEP 64
 660 POKE V+L(X)+B+T,0
```

```
670 NEXT T:NEXT B:NEXT X:NEXT A
700 REM - ***ADDRESS FOR NUMBERS***
710 FOR X=1 TO 63 STEP 2:READ L(X):L(X)=L(X)-64:NEXT
720 DATA 73,85,97,109,195,207,219,231,329,341,353,365
730 DATA 451,463,475,487,585,597,609,621,707,719,731,743
740 DATA 841,853,865,877,963,975,987,999
750 FOR X=2 TO 64 STEP 2:L(X)=L(X-1)+1:NEXT
780 REM - ***PAINT SQUARE NUMBERS***
790 FOR X=1 TO 64:READ N:POKE V+L(X),N:NEXT
820 DATA 176,177,176,178,176,179,176,180
830 DATA 176,181,176,182,176,183,176,184
840 DATA 176,185,177,176,177,177,177,178
850 DATA 177,179,177,180,177,181,177,182
860 DATA 177,183,177,184,177,185,176
860 DATA 177,183,177,184,177,185,178,176
870 DATA 178,177,178,178,178,179,178,180
880 DATA 178,181,178,182,178,183,178,180
890 DATA 178,185,179,176,179,177,179,178
900 REM - ***ADDRESS FOR CHECKERS***
910 FOR X=1 TO 32:L(X)=L(2*X-1)+1:NEXT
920 REM - ***PAINT CHECKERS***
 930 FOR Z=1 TO 4: READ C(Z): NEXT
940 DATA 53,38,25,43
940 DATA 53,38,25,43
950 FOR X=1 TO 12:FOR Y=0 TO 1:FOR Z=1 TO2
960 POKE V+L(X)+Y*64+Z.C(Z+Y*2)
970 NEXT Z:NEXT Y:NEXT X
980 FOR Z=1 TO 4:READ C(Z):NEXT
990 DATA 52,38,25,11
1000 FOR X=21 TO 32:FOR Y=0 TO 1:FOR Z=1 TO 2
1010 POKE V+L(X)+Y*64+Z,C(Z+Y*2)
1020 NEXT Z:NEXT Y:NEXT X
1100 REM - ***COMPUTERS FIRST MOVE***
1105 FOR X=1 TO 200:NEXT
1110 GOSUB 5002
 1110 GOSUB 5002
1115 GOSUB 5065
1120 F=10:T=15
 1130 GOSUB 6000
 1135 REM - ***PLAYER MOVES***
 1140 GOSUB 5502
 1210 GOSHB 7000
  1220 GOSUB 6000
 4999 INPUT A
5000 REM - ***PRINT "MY"***
 5002
           DIM M(22)
 5005 FOR X=1 TO 22:READ M(X):NEXT
5010 FOR X=0 TO 64 STEP 64
5020 FOR Y=1 TO 11
 5040 POKE V+179+Y+X,M(Y+11*SGN(X))
 5050 NEXT Y:NEXT X
5060 DATA 63,63,63,5,53,7,29,53,31,63,63
 5062 DATA 63,63,63,15,63,15,63,15,63,63,63
 5063 RETURN
 5065 REM - ***PRINT "MOVE"***
5070 FOR X=0 TO 64 STEP 64
 5080 FOR Y=1 TO 11
5090 READ Q
 5100 POKE V+307+Y+X,Q
5110 NEXT Y:NEXT X
5120 DATA 38,62,39,37,45,39,39,63,39,37,45
5130 DATA 7,31,7,6,54,7,57,49,63,2,54
 5135 FOR X=1 TO 150:NEXT
 5140 RETURN
 5500 REM - ***PRINT "YOUR"***
5500 DIM Y(22)

5505 FOR X=1 TO 22:READ Y(X):NEXT

5510 FOR X=0 TO 64 STEP 64

5520 FOR Y=1 TO 11
 5540 POKE V+179+Y+X,Y(Y+11*SGN(X))
5550 NEXT Y:NEXT X
  5560 DATA 29,53,31,3,27,7,7,56,56,18,7
 5570 DATA 63,15,63,13,45,15,13,41,57,59,47
 5580 RETURN
 6000 REM - ***READ "FROM"**
 6030 FOR Y=0 TO 1:FOR Z=1 TO 2
6040 F(Z+Y*2)=PEEK(V+L(F)+Z+Y*64)
0040 F(Z*1*2)=FEBR(V*L(F)*2*1*54)

6050 NEXT Z:BEXT Y

6051 FOR B=1 TO 10

6052 FOR Y=0 TO 1:FOR Z=1 TO 2:POKE U+L(F)*Z*Y*64,F(Z*Y*2)

6053 NEXT Z:BEXT Y
 6054 FOR Y=0 TO 1:FOR Z=1 TO 2:POKE V+L(F)+Z+Y*64,63
6055 NEXT Z:NEXT Y:NEXT B
6056 FOR B=1 TO 10
6057 FOR Y=0 TO 1:FOR Z=1 TO 2:POKE U+L(T)+Z+Y*64,63
6058 NEXT Z:NEXT Y
6060 FOR Y=0 TO 1:FOR Z=1 TO 2:POKE V+L(T)+Z+Y*64,F(Z+Y*2)
6070 NEXT Z:NEXT Y
 6075 NEXT B
 6080 RETURN
 7000 REM - ***INPUT ROUTINE***
7010 FOR X=1 TO 6:I(X)=0:NEXT
7010 FOR X=1 TO 6:1(X)=0:NI

7020 A=141

7030 FOR X=1 TO 6

7040 I(X)=INP(124)

7050 IF I(X)=197 THEN 7010

7060 IF I(X)=A THEN 7040

7070 POKE V+503+X,I(X)
7080 A=1(X)
7090 IF I(2)=172 THEN I(3)=I(2):I(2)=I(1):X=3
7100 IF I(5)=141 THEN I(6)=I(5):I(5)=I(4):X=6
 7110 NEXT X
 7120 F=(I(1)-176)*10+(I(2)-176)
           T=(I(4)-176)*10+(I(5)-176)
 7130
 7140 RETURN
```



DIGI-KEY CORPORATION **Quality Electronic Components Double-Digit Discounts**

Save You Even More 2102-1 **A0808** LM3909 69° \$1.99 \$24.95

"Assembled and tested. The IC & other parts are on the back of these compact modules.

NATIONAL SEMICONDUCTOR CLOCK MODULES

MA1010A 12 Hour (AM-PM) Version . . . \$13.00 MA1010C 24 Hour Version \$13.00





Hobby-Wrap-30 \$5.95

Strips, Wraps and Unwraps 30 ga. wire on standard wire wrapping pins



Actual Size Special transformer and 6 switches when ordered with module add \$3.45

0.84" High LED Digits

MA1002 & MA1010 Series **Electronic Clock Modules**

The MA1002 & MA1010 Series Electronic Clock Modules are assembled and pretested modules which combine a monolithic MOS-LSI integrated clock circuit, 4-digit ELD display, power supply and other associated discrete components on a single printed circuit board to form a complete electronic clock movement. The user need add only a transformer and switches to construct a digital clock for application in clock-radios, alarm or instrument panel clocks. Time-keeping may be from 50 or 60 Hz inputs and 12 or 24 hour display formats may be chosen. Direct LED drive eliminates RF interference. Time setting is made easy through use of "Fast" and "Slow" scanning controls.

The MA1002A and MA1010A have a 12 hour display with an AM and PM indicator. The MA1002C and MA1010C have a

Features include alarm "on" and "PM" indicators, "sleep" and "snooze" timers and varioble brightness control capability. The modules are extremely compact, the MA1002 measuring 1.375" by 3.05", the MA1010 measuring 1.375" by 3.05", the MA1010 measuring 1.75" to to the back of the circuit board.

It is highly recommended that the transformer be obtained with the clock module as it is a special dual secondary type not otherwise readily available.

Double Digit Discounts Save You Even More!

ACE201-K \$24.95

STRIP

1,032 SOLDERLESS PLUG-IN TIE POINTS CAPACITY: UP TO 12 14-PIN DIP's TWO 5-way binding posts Size: 4-9/16" by 7"



INTEGRATED CIRCUITS - TTL CMOS LINEAR & MOS

INIE	GRATED CIRC	.0115 — 111.,	CMUS, LINE	AK & MUS
400 .21	7476 .32	74181 2.15	4012 .23	4520
101 .21	7480 .70	74182 .79	4013 .40	4527
02 .21	7482 .70	74184 2.19	4014 .96	4528
03 .21	7483 .70	74185 2.19	4015 .96	4585
04 .21	7485 .89	74188 3.50	4016 .40	2102-1
05 .21	7486 .28	74189 3.50	4017 1.05	8080A
06 .25	7489 2.19	74190 1.23	4018 1.05	CA3046
7 .25	7490 .44	74191 1.23	4019 .23	LM2111N
08 .21	7491 .70	74192 .88	4020 1.14	LM309K
9 .21	7492 .44	74193 .88	4021 1.14	LM324A
0 .21	7493 .44	74194 .88	4022 .96	LM340T-5
11 .21	7494 .70	74195 .88	4023 .23	LM340T-6
2 .21	7495 .70	74196 .88	4024 .84	LM340T-8
3 .25	7496 .70	74197 .88	4025 .23	LM340T-12
4 .89	74100 1.28	74198 1.49	4026 1.68	LM340T-15
6 .25	74107 .30	74199 1.49	4027 .40	LM340T-18
7 .25	74109 .33	74251 1.09	4028 .89	LM340T-24
0 .21	74109 .33	74279 .55	4029 1.14	
1 .25	74121 .33	74365 .67	4030 .23	LM3900N
3 .35	74122 .44		4030 .23	LM3909N
	74125 .61		4033 1.51	MC1456V
			4034 3.50	MC1458V
26 .25	74126 .40		4035 1.14	MC3302P
27 .33	74132 .70	8093 .40	4040 1.14	NE536T
28 .28	74141 .88	8094 .40	4041 .79	NE540L
30 .21	74145 .70	9095 .67	4042 .79	NE555V
32 .25	74147 1.63	8096 .67	4043 .70	NE556A
33 .30	74148 1.30	8097 .67	4044 .70	NE560B
37 .25	74150 1.16	8098 .67	4046 1.86	NE561B
38 .25	74151 .70	75150 1.16	4049 .40	NE562B
10 .21	74153 .65	75450 .88	4050 .40	NE565A
2 .53	74154 1.03	75451 .61	4051 1.26	NE566V
3 .63	74155 .70	75452 .61	4052 1.26	NE567V
5 .70	74156 .70	75453 .61	4053 1.26	uA709CV
6 .70	74157 .70	75454 .61	4060 1.58	uA710CA
7 .70	74160 .88	75491 .81	4066 .79	UA711CA
8 .70	74161 .88	75492 .84	4071 .23	uA723CA
0 .21	74162 .88	75493 1.09	4072 .23	uA733CA
1 .21	74163 .88	75494 1.19	4073 .23	uA741 CV
3 .21	74164 .96	82525 2.19	4075 .23	uA747CA
4 .21	74165 1.15	4000 .23	4081 .23	uA748CV
59 .21	74166 1.26	4001 .23	4082 .23	uA7805CU
50 .21	74170 2.64	4002 .23	4502 .79	uA7806CU
0 .30	74173 1.42	4006 1.23	4510 1.14	UA7808CU
2 .30	74174 .98	4007 .23	4511 1.05	uA7812CU
3 .30	74175 .93	4008 .79	4514 2.80	uA7815CU
4 .30	74176 .79	4009 .44	4515 2.80	uA7818CU
5 .49	74177 .79	4010 .44	4516 1.23	UA7824CU
37	74190 70	4011 02	4510 1.23	UM/ 024CU

SILICON TRANSISTORS

4515 2.80 4516 1.23 4518 1 14

	MPS2222A, /				, MPS3392,
MPS3393, MPS3394,					
MPS3640, MPS3641,					
2N4126, 2N4401, 2N4 PN5134, PN5137, PN51 of same part no.					
MPF102 .36 \$30.60/C \$85.00/C	2N5457 .48	\$41.00/C	MPSA13 .2	8 \$24.00/C	2N3055 .99

ENTIRE ROCKWELL CALCULATOR LINE ON DISCOUNT IN OUR LATEST CATALOG



HOBBY-WRAP Model BW-630 Battery wire wrapping tool \$3495 COMPLETE WITH AND SLEEVE WITH

WIRE WRAPPING WIRE IN BULK Red or Black 30 ga. Kynar 100' \$2 00 500' \$8.50 1000' \$15.00

	SILICON	DIODES	
1 N4001 1 N4002 1 N4003 1 N4004 1 N4005 1 N4006	.64/10 .66/10 .68/10 .70/10 .82/10 .90/10	5.50/C 5.60/C 5.80/C 5.95/C 7.05/C 7.75/C	\$49/I \$51/I \$52/I \$54/I \$63/I \$69/I
1 N4006 1 N4007 1 N4148	.99/10 .99/10 .40/10	8.60/C 3.50/C	\$77/N \$29/N

Double Digit Discounts Save You Even More!

1/2 WATT ZENER DIODES

LN5236B 7.5v .15 \$11/0
1N5237B 8.2v .15 \$11/0
1N5238B 8.7v .15 \$11/0
1N5239B 9.1v .15 \$11/0
1N5240B 10v .15 \$11/0
1N5241B 11v .15 \$11/0
1N5242B 12v .15 \$11/0
1N5243B 13v .15 \$11/0
1N5244B 14v .15 \$11/0
1N5245B 15v .15 \$11/0

SLIDE SWITCHES Single Pole Single Throw

1.20/10 Double Pole Double Throw .23 2.00/10 19.00/C

للا	13:	M	لقا	ΟL	DΕ	
	1-A	A.		260		
	2-A	A.		420		
	1-C			35c		
	2-C			42c		
	1-D					
	2-D			42c		

PERF BOARD ' spacing between holes 4½"x 6" \$1.71 4½"x17" \$4.25

TERMINALS for above perf board \$1.50/C

LED LAMPS

NSL5053 T-1 ¾ .18 \$15/C NSL5056 T-1 ¾ .18 \$15/C

LED DISPLAYS

FND357 CC .375" . \$1.35 FND500 CC .500" . \$1.35 FND 507 CA .500 . \$1.35 FND800 CC .800" . \$2.50 FND807 CA .800" . \$2.50

DATA BOOKS



DATA BOOKS

DATA BULL 15: 595 p. . . \$4.00 Linear IC's 957 p. \$5.00 CMOS IC's 256 p. \$3.00 Transistors 288 p. \$3.00 Memory IC's 592 p. \$3.00 Interface IC's 464 p. \$4.00 Volt. Regs. 128 p. \$3.00 Volt. Regs. 128 p. 53.00 Linear Appl. 1 432 p. 54.00 Linear Appl. 2 246 p. 53.00 Audio 196 p. 53.00 Box 677, Thief River Falls, MN 56701

BISHOP GRAPHICS Printed Circuit Drafting Aids are now available from Digi-Key

RADIAL ELECTROLYTICS

.47/50V08	.65/10	22/50V12	1.00/10	1	330/25V 23	1.86/10
1/50V 08	.65/10	100/6.3V09	.75/10		470/10R 21	1.71/10
2.2/50V08	.65/10	100/10V10	.77/10	1	470/16V 23	1.81/10
3.3/50V08	.65/10	100/16V11	.85/10	1	470/25V 29	2.35/10
4.7/35V 08	.65/10	100/25V13	1.10/10	-	1000/10V . 24	1.96/10
4.7/50V08	.68/10	100/50V21	1.71/10	-	1000/16V . 29	2.35/10
10/16V 08	.65/10	220/10V13	1.08/10	1	1000/25V . 42	3.33/10
10/25V 08	.65/10	220/16V15	1.16/10	-	2200/10V . 42	3.33/10
10/50V 10	.75/10	220/25V21	1.71/10	1	2200/16V . 54	4.30/10
22/16V 08	.67/10	220/50V29	2.35/10	1	2200/25V . 58	4.67/10
22/25V 09	.70/10	330/10V15	1.16/10	1	3300/16V . 89	7.14/10
	1000011000	330/16V 21	1.66/10	1		

AXIAL ELECTROLYTICS

	AAI	AL LELCI	COLITI	CS	
1/30V 11 3.3/35V 12 1.3/35V 12 4.7/25V 11 4.7/35V 12 4.7/50V 12 10/25V 12 10/50V 14 122/16V 12 22/25V 13	.90/10 .90/10 .90/10 .95/10 .00/10 .95/10 .00/10 .00/10 .00/10 .05/10 .05/10	33/25V. 14 33/50V. 19 47/16V. 14 47/25V. 17 47/50V. 21 100/10V. 14 100/16V. 17 100/25V. 20 100/50V. 29 220/10V. 18 220/16V. 29 220/16V. 29	1.15/10 1.52/10 1.15/10 1.30/10 1.17/10 1.13/10 1.30/10 1.55/10 2.30/10 1.55/10 2.35/10	330/16V . 29 330/25V . 32 470/16V . 32 470/25V . 37 1000/10V . 33 1000/16V . 33 1000/16V . 50 2200/10V . 50 2200/16V . 62 2200/25V . 79 3300/16V . 92 4700/16V 1.09	2.35/10 2.54/10 2.55/10 3.00/10 2.65/10 3.15/10 4.50/10 4.95/10 6.36/10 7.63/10 8.70/10
22/50V17 1					

WIRE-WRAPPING TOOL

\$5.95

Wraps, Unwraps & Strips 30 ga. Wire

1/4 & 1/2 WATT 5% CARBON FILM RESISTORS

5c each in multiples of 5 per value \$1.70/100 & \$12.00/1000 of same value 1 ohm thru 1.0 megol

HARDWARE

2-56 1/4 Screw .99/C 7.20/M
2-56 1/2 Screw .99/C 7.65/M
4-40 1/4 Screw .55/C 3.60/M
4-40 1/2 Screw .60/C 4.05/M
6-32 1/4 Screw .65/C 4.40/M
6-32 1/2 Screw .75/C 4.85/M
8-32 3/8 Screw .90/C 5.85/M
8-32 5/8 Screw .99/C 7.00/M
2-56 Hex Nut .55/C 3.60/M
4-40 Hex Nut .55/C 3.75/M
6-32 Hex Nut .60/C 4.00/M
8-32 Hex Nut .60/C 4.15/M
No. 2 Lockwasher .85/C 5.75/M
No. 4 Lockwasher .45/C 3.00/M
No. 6 Lockwasher .45/C 3.00/M
No. 8 Lockwasher .45/C 3.00/M

IC SOCKETS

1.C. 30Ch	EIS
8 Pin Solder .17	1.60/10
14 Pin Solder .20	1.90/10
16 Pin Solder .22	2.10/10
18 Pin Solder .29	2.75/10
24 Pin Solder .38	3.60/10
28 Pin Solder .45	4.25/10
40 Pin Solder .63	6.00/10
8 Pin W-W .24	2.30/10
14 Pin W-W .26	2.50/10
16 Pin W-W .30	2.85/10
18 Pin W-W .60	5.70/10
24 Pin W-W .96	9.10/10
28 Pin W-W 1.12	10.00/10
40 Pin W-W .92	8.75/10

DOUBLE-	DIGIT DI	SCOUNT SCH	EDULE
Merchandise	Discount	Merchandise	Discount
\$ 0.00-\$24.99	NET	\$100.00-\$499.99	
\$25.99-\$99.99	Less 10%	\$1000.00 & Up	Less 25%
Then Ad	d the Star	ndard Charge	Below

STANDARD SHIPPING/HANDLING CHARGE

If your merchandise total after discount is between 0.00-\$ 4.99 .. add \$2.00 \$ 50.00-\$99.99 . add \$0.25 5.00-\$24.99 .. add \$0.75 \$100.00 & up .. No Charge 5.00-\$49.99 .. add \$0.50

COD ORDERS ACCEPTED FOR SAME DAY

"Only Quality Components Sold!"
DON'T FORGET TO APPLY DISCOUNT SCHEDULE



DIGI-KEY CORPORATION

218-681-6674

Z80 MITS 12K EXTENDED BASIC PATCHES

By Martin D. Gray

It is amazing how quickly you can become tired of swapping Z80 and 8080 CPU boards of the IMSAI 8080 microcomputer whenever there is a basic program to run. The following patches are the result of several days' work studying disassembly listings (what the world needs is a good annotated disassembler). The problem with MITS Basic for the 8080 CPU is the conditional parity operations; JPO JPE CPO CPE RPO RPE.

The 12K basic seems to be a mix of the conditional jumps and returns. Fortunately, the RPE and RPO instructions follow an RST 6, allowing a simple patch of the RST 6 and avoiding the use of the only remaining one byte call (RST 7). The three byte jumps are

then patched one at a time with a common macro. This works well on my 12K basic, but I understand that there are several versions around and it would not be a bad idea to check the patch locations to see that they agree with your basic.

These patches were written and assembled on the TDL Relocating Assembler and the object can be loaded anywhere there are 0055H unused bytes. The assembler puts all address fields MSB first, so remember when you key in the patches, to swap the order of these fields. The patches work only for the Z80 CPU. The two Z80 instructions RES and SET must be changed to 8080 type instructions for the patches to work on both Z80 and 8080 CPUs.

```
.TITLE /MITS 12K BASIC AND ESP-1 Z-80/
.SBTTL NEV 2 11/26/76 MITS 3.2 ACR BASIC Z-80 PATC
                                                                                                                                                  0015' E2 001C'
0018' F1
0019' C3 0CED
001C' F1
                                                                                                                                                                                                JPO
POP
                                                                                                                                                                                                                 .0002
                               MACRO DEFINITIONS
                                                                                                                                                                                                               OCEA+3
                                . DEFINE PATCH(ADRS. BRANCH. DP. INSERT. ZEXPND. ZSKIP) = [
                                                                                                                                                                                                  РПР
                              .DEFINE PATCH (ADBS, BPARCH-OP, INSERT, XEXPND, XSKIP)
.LDC ADPS ::PATCH JPD, JPE HERE
JMP MEXPND ::JUMP TO EXPRNSION
.RELDC ::BACK TO NEXT SEO LOC
XEXPND: PUSH PSW ::SAVE STATUS
'INSERT ::STICK OP INSERT HERE
ANA A ::GET ACCUM PARITY
'OP MSKIP ::TEST PARITY AND BRANCH
                                                                                                                                                                                                PUSH
                                                                                                                                                  0020' F5
0021' A7
                                                                                                                                                                                 +..0003:
                                                                                                                                                  0022' E2 0029'
0025' F1
0026' C3 10BF
0029' F1
                                                                                                                                                                                                               ..0004
PSU
                                                                                                                                                                                                 IPI
                                                             PSW HDRS+3 ::COND NOT MET
PSW BRANCH ::COND IS MET)
                                                                                                                                                                                                               10BC+3
                                                                                                                                                  002A, C3 10C0
                                                                                                                                                                                               PATCH
                                                                                                                                                                                                              229A, 22F4, JPE, SUI
                               JMP BRAN
.DEFINE REL[ADPS]=[
                                                                                                                                                           C3 00SD
                                                                                                                                                                                                               ..0005
PSW
                                                                                                                                                                               +...0005: PUSH
                                                                                                                                                  002E' P5
002E' D605
0030' A7
0031' EA 0038'
0034' F1
                                                            ADRSI
                                                                                                                                                                                               SUI
ANA
JPE
POP
                                              .100
                               FIX RST 6 HERE
0035
                                                                                                                                                  0035′ C3 229D
0038′ F1
         C3 0000
                                               JMF
                                               . RELOC
0000
                                                                                                                                                                                +..0006:
                                                                                                                                                                                                 POP
                               9ST6:
                                                                                                                                                  0039' C3 22F4
                                                                                                                                                                                                JMP
PATCH
                                              DOR
DOR
DOR
PUSH
XTHL
ANA
JPE
00001
00012
00022
00034
00042
00052
                                                                                                                                                                                                               118C, 1178, JPDE
                                                                                                                                                                                               JMP
PUSH
ANA
JPD
POP
                                                             PSW
                                                                                                                                                 003C' F5
003D' A7
003E' E2 0045'
0041' F1
0042' C3 118F
0045' F1
                                                                                                                                                                                                              ..0008
PSW
118C+3
                                                                           GET PARITY
                                                            2,1
           CB95
                                               RES
                                                                                                                                                                               +..0008:
000B
                                                                                                                                                                                                 POP
                                                                                                                                                  0046' C3 1178
                                                             PSW
                                              POF
0000
                                                                                                                                                                                               PATCH
                                                                                                                                                                                                              1882,905, JPE [
                                                                           SET PARITY FLAG
                                                                                                                                                                                                PUSH
ANA
JPE
PDP
                                                                                                                                                  004E' F1
004F' C3 1885
0052' F1
                               HERE COME THE Z-80 MACRO PATCHES
                                                                                                                                                                                                              1A82+3
PSW
                                                                                                                                                                              +..0010:
+
                                              .RADIX
                                                             16
OCEA, OCFD, JPDI
                                                                                                                                                                                                 POP
                                                                                                                                                  0053' C3 0905
                                                                                                                                                                                                JMP
.RADIX
0CEA C3 0013'
0013' F5
                              +..0001: PUSH
```

138 INTERFACE AGE MARCH 1977

S.D. SALES CO. P.O. BOX 28810 - @

DALLAS, TEXAS 75228

JUMBO LED CAR CLOCK



THE HOTTEST SELLING KIT WE EVER PRODUCED!

You requested it! Our first D.C. operated clock kit. Professionally engineered from scratch. Not a makeshift kluge as sold by others. Features:

A. Bowmar Jumbo -.5 inch LED array.

MOSTEK - 50250 - Super Clock Chip.

On board precision crystal time base. D. 12 or 24 Hr. Real Time Format.

Perfect for cars, boats, vans, etc.

P.C. Board and all parts (less case) included.

50,000 SATISFIED CLOCK KIT CUSTOMERS CANNOT

THIS MONTH'S SPECIALS

AMD - 8080A \$14.95 **Z-80 CPU** 49.95 82S129 1K PROM

1702A 2K EPROM

We tell it like it is. We could have said these were factory new, but here is the straight scoop. We bought a load of new computer gear that contained a quantity of 1702 A's in sockets. We carefully removed the parts, verified their quality, and are offering them on one heck of a deal. First come, first served. Satisfaction guaranteed!

U.V. Eraseable. \$6.95 ea. 4/\$25

UP YOUR COMPUTER! 21L02-1 1K LOW POWER 500 NS STATIC RAM Time is of the essence!

And so is power. Not only are our RAM's faster than a speeding bullet but they are now very low power. We are pleased to offer prime new 21L02—1 low power and super fast RAM's. Allows you to STRETCH your power supply farther and at the same time keep the wait light off. 8 for \$12.95

60 HZ CRYSTAL TIME BASE S.D. SALES EXCLUSIVE!

\$5.95 ea.

2/\$10.00

KIT FEATURES:

- A. 60HZ output with accuracy comparable to a digi-
- B. Directly interfaces with all MOS clock chips.
- C. Super low power consumption (1.5 MA tvp.)
- D. Uses latest MOS 17 stage divider IC.
- E. Eliminates forever the problem of AC line glitches.
- Perfect for cars, boats, campers, or even for portable clocks at ham field days.
- G. Small size; can be used in existing enclosures. Kit includes Crystal, Driver IC, PC board, plus all necessary parts and specs. At last count - over 20,000 sold!

Slide Switch Assortment

Filter Caps
Rated 35 WVDC
Upright style
with PC leads.
Most popular
value for hobbyvalue for hoppy-ists. Compare at up to \$1.19 ea. from franchise type electronic parts stores. S.D. Special 4/\$1.

1000 MFD

Our best seller. Includes mini-ature and stan-dard sizes; single and multi-position units. All new, first name brand. Try one package and you'll reorder more! Special 12/\$1.00

RESISTOR ASSORTMENT 1/4W 5% & 10% PC leads. A good mix of values.

200/\$2.

7400—19c 7411—29c 7451—19c
74LS00—49c 7413—50c 7453—19c
7402—19c 7416—69c 7473—39c
74LS02—49c 7420—19c 7474—35c
7404—19c 7430—19c 74LS74-59c
74504—49c 7432—34c 7475—69c
74S04—44c 7437—39c 7476—35c
74LS04-49c 7438—39c 7480—49c
7406—29c 7440—19c 7483—95c
7408—19c 7447—85c 7485—95c
7410—19c 7448—85c 7486—45c
TTL INTEGRATED CIRCUITS 7490—65c 74153—75c
74LS90—95c 74154-1.00
7492—75c 741561—95c
7495—75c 74164-1.10
7496—89c 74165-1.10
74121-38c 74174—95c
74123-65c 74181-2.50
74132-1.70 74191-1.25
745138-1.95 74192-1.25
74141-75c 74193-1.00
74195—69c

P.C. LEAD DIODES 1N4148/1N914 100/\$2.00 1N4002-1A. 100 PIV 40/\$1.

HEAVY DUTY Full Wave Bridge 25 AMP 50 PIV \$1.25

S.D. SALES EXCLUSIVE

\$12.95 MOS 6 DIGIT UP—DOWN COUNTER \$12.95
40 PIN DIP. Everything you ever wanted in a counter chip.
Features: Direct LED segment drive, single power supply (12
VDC TYPE.), six decades up/down, pre-loadable counter, separate pre-loadable compare register with compare output, BCD and seven segment outputs, internal scan oscillator, CMOS compatible, leading zero blanking. 1MHZ. count input frequency. Very limited quantity! WITH DATA SHEET

Disc Cap Assortment PC leads. At least 10 different values. Includes .001, .01, .05, plus other stan-dard values. 60/\$1.00

\$9.95 KIT

P.C. Board - 3.00 AC XFMR - 1.50

Do not confuse with Non-Alarm kits sold by our competition! Eliminate the hassle avoid the 5314!

SIX DIGIT ALARM CLOCK KIT

We made a fantastic kit even better. Redesigned to take advantage of the latest advances in I.C. clock technology. Features: Litronix Dual ½" displays, Mostek 50250 super clock chip, single I.C. segment driver, SCR digit drivers. Greatly simplified construction. More reliable and easier to build. Kit includes all necessary parts (except case). P.C.B. or XFMR optional. NEW! WITH JUMBO LED READOUTS! optional.

Motorola SCR 2N4443. 8 AMP 400 PIV. P.C. Leads 3/\$1

FAIRCHILD - TBA 641 4W. Audio power Amp. Just out! In special heat sink DIP. One super audio IC. \$1.50 with data

FND-359 -Led Readout .4 IN. Common Cathode. High effeciency. Has FND-70 PIN OUT. 59c

OUR CATALOG is chocked full of rare parts bargains, deals, RAM or CPU kits, plus much more. Yours FREE!

PRICES SHOWN SUBJECT TO CHANGE WITHOUT NOTICE.



A very fortunate purchase. One of the best industrial quality REG-ULATED supplies we have seen. High performance, small size. Input is 120 VAC 60 HZ. Has the following regulated outputs: -5VDC@800MA; -15VDC @ 1.25 AMP; -25VDC @ 180 MA. Sold at a fraction of original cost. Do yourself a favor and order NOW. We expect a quick sellout.

COMPUTER POWER SUPPLY

NEXT MONTH:

S.D. will have music for your ears. Watch our ads.

For your Imsai or Altair 8080 Computer: Z-80 CPU Kit - \$149. 4K Low Power Ram Kit - \$89.95

Terms: Money back guarantee. No COD. Texas residents add 5% sales tax. Add 5% of order for postage & handling. Or-ders under \$10. add 75c. Foreign orders: US funds Call your Bankamericard or Master Charge order in on our continental United States toll free Watts:

1-800-527-3460 Texas Residents Call Collect: 214/271-0022

Special Thanks to: Dennis, Fred, Abe, Bill, Sam, Hal, Tom, Alex, John, Ely, and Larry

S.D. SALES CO. P. O. BOX 28810 Dallas, Texas 75228

Letters to the Editor

Dear Editor:

As a recent subscriber to both BYTE and Interface Age, let me say that I have found your publication more informative than BYTE.

As a computer professional, I am fascinated by the thought of my own system at home, and I look forward to your publication being a major source of information in selecting my system, and in using it after purchase . . .

George R. Woodside Fairview, Pa.

Dear Editor:

I am looking forward to that year in the future when our \$4,000 microcomputers will compute numbers as well as today's \$39.95 pocket calculators.

> Edward Loring Tottle Baltimore, Md.

Dear Editor:

I would like to contact persons who have a serious personal interest in using a microcomputer for stock and commodity market investment purposes. If covariance is more than just another word to you, send a brief note of your desires, qualifications, and market experience/involvement to: J. Williams, 2415 Ansdel Court, Reston, Vir. 22091. An association is being formed.

Jack M. Williams Reston, VA

Editor's Note:

See the Feb. issue of INTER— FACE AGE for the Microcomputer Stock Options article by Edward Christianson. Good luck in organizing your association.

Dear Editor:

I just read my first copy of INTERFACE AGE magazine; I think it's great. I have just started building up my own microcomputer system. I am interested in sharing ideas with other experimenters in the Houston area.

Paul Roddy Houston, Tx.

Dear Editor:

I think Interface Age is really great. Keep up the excellent work. Enclosed is a check for \$10.

Ralph Voss

Dear Editor:

A colleague and I have a pair of IMSAI's with Z-80 CPU's up and running in parallel, and are working on interfacing them to an audio-video electronic arts lab. We have already found a number of your articles invaluable, but our few borrowed and newsstand copies are getting very dogeared. And we would rather support your magazine with a subscription (and stay within the letter of the new copyright laws) than try to xerox old copies that are worn to illegibility.

Hoping you can help, I'll appreciate your attention to this matter.

Hollis Frampton Buffalo, N.Y.

Dear Editor:

I just saw the Jan. '77 issue of your magazine. It looks like the answer to my ego problem.

Digital group's Z-80 system was so well designed that now I have this 19" eye glaring at me. It seems to be saying, "Now what do you want, neophyte?". Your software section is just the answer I need.

Matthew S. Osborn Minneapolis, Mn.

Dear Editor:

Please enter one year subscription to your magazine for the above given address. Please start from the January '77 issue.

I have several copies from 1976 that I purchased at the "Personal Computing 76" in Atlantic City, and I can say that your magazine

is one of the best. Keep up the good work.

Antonio Ferrante Ottawa, Canada

Dear Editor:

I have very basic knowledge about microcomputers. I hope your magazine will not scare away people who otherwise might be interested in learning about and actually getting and using a microcomputer, with PhD styled lollypopped-choked technological wizard's language instead of plain laymans English. Of course, knowledge is like a pyramid, I hope you can give every subscriber something to build on, which will be the key to your success.

Sincerely I hope you will be a success. I am sure you will send me a copy (last month's) as soon as you recieve this letter.

> Edward A. Krysher Pt. Richey, Fla.

Dear Editor:

If you would make the following request known to your readers you would do both them and I a great service.

I would like to get together with some other people who have access to an APL system or are looking ahead to their own microprocessor based APL system, and would like to build or modify a CRT or dot matrix impact terminal to display the APL/ASCII character set.

I have some ideas which I will share on how to incorporate overstrike capability in a CRT terminal inexpensively, but the charcter generator is the problem. APL character generator ROMs are nearly impossible to acquire and I would like to have one manufactured.

If anyone is interested please send me your name and address along with any comments you may have. For example, would you prefer 5 X 7 (similar to the APL Decwriter) or 7 X 9 character matrix? If I perceive sufficient interest I will have the chip encoded and send you information. I expect cost per chip to be less than twenty dollars (\$20).

Phillip Apley Amherst, MA

MICRO-MARKET

MICRO-MARKET AD RATE:

\$25.00 per column inch. Max. 4 column inches per ad. Submit ads to Micro-Market Ads-INTERFACE Magazine, P.O. Box 1234, Cerritos,

SOUTH FLORIDA Sunny Computer Stores, Inc.

Authorized Dealer: IMSAI, Southwest, Cromemco, CSC, Vector and others Books, Magazines, Newspapers, Service and Supplies

University Shopping Center 1238A South Dixie Highway Coral Gables, Fla. 33146 (305) 661-6042

ADD COLOR TO EXISTING TV GAMES WITH A"CHROMA-PLEX 7700" DIGITAL CHROMA MULTIPLEXER KIT!

EASILY ADAPTED TO MOST BLACK and WHITE GAMES. (i.e., Ceneral Instrument 6-game chip #AY-9-8500.) CMOS MOS FET CIRCUITRY. LOW POWER REQUIREMENTS: 7.0 V rgs. @ 25ma. 3-5 8" x 4" double-sided plated board. DOZENS OF COLON COMBINATIONS POSSIBLE. VERY VERSATILE. EASILY ASSEMBLED IN ONE EVENING. \$35.00 P.P. ORDER BY PHONE or MAIL. DIAL 402 987-3711. DAKOTA CITY, NE. 68731



THE COMPUTER CORNER

"Brains are our Business"

✓ IMSAI 8080, POLY-88, Processor Tech ✓ Books, Magazines, TTY Supplies, Brain Games Hours: 10-6 pm daily & Sat.; Thurs. 10-9 pm White Plains Mall, 200 Hamilton Ave.

WHITE PLAINS, NY 10601 Telephone: (914) 949-DATA

AMCO HAS APPLE!

APPLE COMPUTERS

AMCO ELECTRONIC SUPPLY 635 E. ARROW HIGHWAY AZUSA, CA 91702 Phone: (213) 332-2216

COMPUTER HOBBYISTS! Nationwide Classified Advertising Newsletter Buy & Sell Hardware & Software

new/used/unique/low-cost \$3.75 for 18 issues.

Free sample issue on request.
ON_LINE Newsletter
24695 Santa Cruz Hwy, Los Gatos, Ca. 95030

11 11

CHEAP TIME SHARING SERVICE

BASIC, FORTRAN and TDS (a really powerful text editor), at 30 cps, for \$10.00/hr attach time. Only other cost is low monthly disc storage cost with first 10K free. Same-day offline printing, IBM-compatible mag tape preparation; CRT and hard-copy terminal rentals available. 7:00 pm to 7:00 am Mon-Saturday. Minimum billing \$20.00

billing \$20.00.
Interested? Write RSD Inc., 5215 Sepulveda Suite 13D, Culver City CA 90266. Seriously interested? Include \$20.00 deposit. The number of users admitted to the system will be limited, to allow reasonable access.

AM 1702A-6 SPECIAL

%6[∞] each

ANCRONA

E-PROM

ORIGINAL AMD 1.5 MSEC GUARANTEED REGULAR AMD PRICE 1-9 10 up 100 u 23.10 17.40 15.00 8 for \$4500 15.00

MINIMUM ORDER \$10.00 ADD \$1.00 POSTAGE & HANDLING CAL. RESIDENTS ADD 6% S.T

→ (213) 641-4064

21 SHOESTRING START-AT-HOME COMPUTER BUSINESSES

113 page research report uncovers areas never published. \$12.00 (Check, Mastercharge, Bankamericard) Guaranteed Refundable

DATASEARCH

730 Waukegan, Suite 108-F Deerfield, IL 60015

Computer Mart of New York Inc. 314 Fifth Ave. ★ New York, N.Y. 10001

Microcomputers, Books, Components, Parts Authorized Dealer—Service—Friendly Advice Closed Monday

Open 10-6 Tues.-Sat.

10-9 pm on Thurs. Storekeeper

Telephone (212) 279-1048

ELIMINATE INTERFERENCE

Keep Power Line noise & transients out of your system Bonus! No more TV, Stereo or Radio interference. Wires directly into computer, teletype, power supply. Postpaid. \$9.50 — 3 amp Line Filter ELF-10 \$12.50 - 10 amp Line Filter Filter/Transient ELF/T-3 (3 amp) \$14.25 Suppressor ELF/T-10 (10 amp) \$17.25

ELECTRONIC SPECIALISTS, INC. 171 So. Main, Natrick, Mass 01760

TELETYPES \$800

Model 33 ASR . Newly refurbished RS232 • full/half duplex

30 day warranty

THE MULL COMPANY

920 Laurel Avenue Menlo Park, CA 94025 (415) 327-7509

LONG ISLAND

IMSAI Dealer

COMPUTER MICROSYSTEMS

Kits • Parts • Service • Books • Magazines 1309 Northern Blvd., Manhasset, N.Y. 11030

Telephone (516) 627-3640

End your video display problems quickly with a "PIXE-VERTER

TV cameras. v

DIAL 402-987-3771 -

garch 13-1 BROADWAY DAKOTA CITY, NEBR. 6873

★ 1702A PROM PROGRAMMING SERVICE ★ EPROM copy - \$1 Hex form input - \$3 Prime 1702A - \$9. Software available including: Program loaders, Memory checkers, Video drivers and Code convertors.

We offer: Fast turnaround, free coding forms, quantity discount. Write for free catalogue. MICROTRONICS

P.O. Box 7454F

Menlo Park, CA 94025



A.D.M.

Communications, Inc.

Teletype & Communications Equipment Buy—Sell—Recondition 1322 Industrial Ave. Escondido, CA 92025 (714) 747-0374 Telex. 695097

Market Your Software

Call or Write

Microcomputer Software Depository

2361 East Foothill Boulevard Pasadena, California 91107

(213) 449-0616

micropower BODY SHIELDS



EXPRESS YOURSELF

Get a Micropower T-Shirt. Only \$4.95ea.

white small

blue _medium _ Total Enclosed \$

Send ad to:

VAMP Inc. Box 29315 Los Angeles, CA 90029

FIFO FLEA MARKET

FOR SALE: 1-8 Level Tally Parallel Punch—50 Character/Second, \$150, 1-8 Level Parallel Reader—75 Character/Second, \$150, 1-ASCII Keyboard Parallel Output with Strobe Power Supply, 2 Key Rollover, \$100, 1-Baudot Keyboard Parallel Output—2 Key Rollover, \$75, 1-Model 35 RO on Floor Stand, \$450, 1-Hal Video Display ASCII Parallel or Serial 110 or 300 Baud, \$350, 1-8008 Computer with 14 K RAM—2 K ROM & Software Complete with Power Supply*, \$750.

*Will Convert to 8080 for \$100. Call Rick Scappatuna, 914-235-

1766, Days.

SR-60 PROGRAMMABLE DESK-TOP CALCULATOR: Markline Inc. has recently opened offices in New York City to sell the Texas Instruments SR-60, printing, prompting, programmable calculator. The SR-60 handles problems in seconds, that previously took hours. Prices for the SR-60 start at \$1695. Markline Inc. 36 West 44th Street, New York, NY 10036.

FOR SALE: POLY-88 ASSEMBLED Includes CPU w/1/2K Ram, sockets for 3K Prom Vectored Interrupt, Real Time Clock; 1K Monitor (2.2 or 4.0) in 2708 EPROM; Video Interface with 64 character option & 48 x 128 graphics. Parallel I/O Port on Board Backplane fully populated with 100 pin connectors completely assembled and tested. PRICE \$695. (Regularly \$795.) CONTACT: Bruce Carson, 15804 Arcturus Avenue, Gardena, CA

90249. Home: (213) 532-5074, Bus: (213) 588-6131 X263.

FLOPPY DISCS, \$4.00 each. Computer tape 800 BPI, Ampex, Memorex, IBM—\$4.00/reel. Guaranteed. Trimble, 5835 Herma, San Jose, Ca. 95123. 408-224-0606.

CLEANING HOUSE—4004, 8008, 6501, 6502 other IC's, PC boards etc. Send SASE for complete list to Ron Angstadt, RD#3 Box 281, Kutztown, Pa. 19530.

FOR SALE: Altair 8800 with PTC 16 slot terminated mother board and 16 diallyl phthalate connectors. Includes all documentation. Unit in perfect working order. \$650. L. S. Mohler. Call evenings 714-998-5831.

FOR SALE: Two SEALS 8KSC memory boards. Fully assembled and tested NEW \$325.00 each. Also 5203 EPROMS can be erased and reused. \$3.50 each. GARY STILLMAN 5501 W. Windsor, Phoenix AZ 85035.

FOR SALE: MITS 8800 with 13k RAM, PT 16-slot motherboard, parallel I/O board wired for TTY, 8k Basic. \$900. Also 2 additional parallel I/O boards and a PT 3P + S at \$75.00 each. Bill Gordon, 7012 Convoy Court, San Diego, Ca. 92111. 714-278-0630.

WANTED: Information about the Friden 7102 Communications Terminal. Especially the Circuitry. Contact Eugene L. Langberg (WA3AKK) at Gwynedd Valley, Pa. 19437.

FOR SALE: One Altair 8800, new, assembled but not tested, \$439. 2-Altair 4K Dynamic boards, \$200/each. Send replies to: Robert Stodola, 1910 Beechwood Ave., St. Paul, MN 55116.

35 KSR FOR SALE: Either friction or sprocket feed. 20 mil loop

Now Avaliable for Immediate Delivery



Remanufactured Teletypes
Model M-33 ASR or KSR
Like New Condition
90 Day Warrantee

Prices **\$840.00** ASR (Paper tape punch and tape reader)

\$725.00 KSR

Accoustic Couplers and RS-232 inter face available Prices F.O.B. Howell N.J.

For Information Contact

B&M COMMUNICATIONS

R.D. 4 Box 272 Howell, N.J. 07731 201–780-1880 8 level ASCII, Doug 714-747-0374, Ron, 213-377-5822.

FOR SALE: Altair 8800 computer with 2 MITS 4K Dynamic memory cards, 88-ACR cassette interface, 88-2SIO serial board, 88-PIO parallel board, 2-Expander boards, 8K Basic on Cassette. Not completely assembled. Original cost was over \$1200—will sell for \$750. Bob Majdanski, 214 Coolidge Ave. Hasbrouck Heights, N.J. 07604. (201) 288-3742 after 7 p.m.

2-8K MEMORY BOARDS FOR DIGITAL GROUP SYSTEM \$180.00 each. Both have 7K of 21L02-1 and 1K of 2102-1 now running on a Z-80 system. Send S.A.S.E. and check will be returned if boards already sold. Tom Ringate (612) 881-8743, 2811 W. 112th St., Bloomington, MN 55431

FOR SALE: 1103 1K X 1 RAM by Intel with in house numbers. Each one individually tested with several patterns and guaranteed to meet 1103 specs. I must sacrifice 280 of these and must sell in one lot. Metal tubes are included to protect the chips during shipping. Think of what you can do with 35K of memory!! The order could also be split with a friend. You cannot beat the low price of \$0.80 each. I will pay shipping costs. Act quickly and send a cashiers check or money order only to: Stephen Marcus, 1284 West Camino Desierto, Tucson, Arizona 85704.

FOR SALE: Friden Flexowriter Model 2303 with paper tape punch/reader, 7 level, types 100 WPM in upper and lower case,

works well recently serviced, can be converted to ASCII, \$150.00 plus shipping, J.E. Upchurch, Box 1987, Sebring, Fla., 33870, 813-385-2788.

FOR SALE: HP-65, including a case, charger, manuals, programming forms, over 100 magnetic cards with tested, prerecorded programs, and 40 blank magnetic cards for your new programs. Any of over 140 HP-65 Users' Library programs available for copying cost. Remember, the HP-65 is faster than the HP-67, so is better for problems where speed is needed. Price, \$300. Delmer D. Hinrichs, 2116 S. E. 377th Ave., Washougal, Washington 98671.

COMING IN APRIL ISSUE...

"MIKE"—A Computer-controlled Robot
by Tod Loofbourrow
L.E.D. Flasher (For Dasher or Any Other)
by Nathan Loofbourrow
An exciting report authored by two brilliant children. Today they build sophisticated toys; tomorrow will they build translusic warp drives?

Building a Digital Group System by Donald O. Southwick Valuable information for our hardware readers

EXMON—6800 Extended Monitor System by Michael Burton Program Libraries Useful tools for our software readers

More Games!

Game of Life Star Lanes Shooting Stars

-and many other features

Vectored from Page 101

toward the large computer as an answer to the satisfactory development of a CAI system. With today's fast, low cost minis, a single user or small timeshared CAI system could be designed utilizing a home computer; the limiting item would be the auxiliary storage, not the size of the machine. Primarily because such low cost mini-computers were not accessible at the time of

writing this manual, Silvern has not taken this into account, and, as a result of this omission, the cost analysis he presents is somewhat out of date.

Although the author provides a detailed description of the requirements for an instructional programmer, including the patience of a saint, he makes no mention of the technical qualifications of the reader who is

to implement such a system. He does state, however, that computer people will not be comfortable reading this manual. And this is a point with which we heartily agree.

PRINCIPLES OF CAI is available by special order from Education and Training Consultants Co., Box 49899, Los Angeles, California 90049.

ADVERTISING INDEX

Information Inquiry Number		Page	Information Inquiry Number		Page
MANUFACT		Lugo		Vantas Electronica	
38		F0	.39	Vector Electronics	
	A P Products	58	45	Vector Graphics	
42	Associated Electronics		4	Wave-Mate	5
60	BYTE Magazine		28	Wyle Computer	46
11	Comptek		10	Zybek	12
31	Computer Electronics		*Advorticer	requests direct contact.	
	Computer Faire	79	Auvertiser	requests unect contact.	
7	Continental Specialties	9	COMPLITE	RETAILERS	
2	Cromemco	1	47	A-Vid Electronics	67
3	Digital Group		65	Bits N Bytes, Fullerton, CA.	
16	United States		56		
	Robotics Society	18		Byte, Inc.	83
33	E & L Instruments	53	51	Byte Shop, Long Island, NY	
17	Expandor		66	Byte Shop, Miami, FL	
34			49	Byte Shop, Pasadena, CA	71
34	Fabri-Tek		50	Byte Shop, South Carolina	
	HAL Communications	-	53	Byte Shop, Tempe, AZ	75
18	Heath Company	19	52	Cheap, Inc	74
20	iCom	21	59	Computer Components	91
*	IMSAI	CIII	77	Computer Enterprises	124
44	Intelligent Systems 64	64A	78	Computer Mart, NY	124
29	Microcomputer Associates	46	61	Computer Store, Santa Monica	
36	Micro-Term	56	57	The Computerist	
24	Mini-Term		58	Disc 3	
15, 30	MITS 1		64	Electronics Warehouse	
22	MPI		46		101
40	National Multiplex			Matrix Publishers	
26	National Semiconductor		67	Micro Computers	119
6	OK Machine & Tool		37	Osborne & Associates	57
200			54	People's Computer Shop	76
21	Ohio Scientific Instruments		35	Personal Computing '77	55
9	Omni Systems.		43	Scientific Research	63
32	PAiA		48	Sunshine Computer	70
12	Parasitic Engineering 1		63	Synchro-Sound	99
27	Peripheral Vision	43			
	Polymorphic Systems	59	SURPLUS S		
8	Prime Radix	11	69	Advance Microcomputer Products	127
5	Processor Technology	7	70	Atwood Enterprises	131
23	Sharp & Associates	29	75	B & M Communications	142
1	SWTPC	CII	68	Data IV	120
14	Sylvanhills	14	73	Digikey	137
25	Technical Design Labs	37	72	Integrated Circuits Unlimited	135
41	Triple i		71	Jade Company	133
76	Ultrabyte		62	Quest	97
			74	S & D Sales.	139
13	Vamp	14	14	S and Sales	139

CAST YOUR VOTE

The authors in this issue would like to know your feelings as to which article you consider the best. You may cast your vote on each article or only one, which you prefer. The articles are graded on point scale 1 (lowest) to 10 (highest). At the end of the voting period all votes will be tallied and the highest scoring article will be announced and the author will receive \$100 bonus.

NOTE: Use Original "Voting and Reader Service Card" only. Any other form is not acceptable.

INTERFACE AGE Magazine 7 Post Office Box 1234 Cerritos, CA 90701 My favorite article this month was: My name is ______ address _____ City/State/Zip ____ Please fill in this coupon and mail to above address.

ARTICLE

- 1 Menace of the Micro World by Ken Berkun
- 2 Reflections on the Past and Thoughts About the Future of Semiconductor Technology

by Dr. C. Lester Hogan

- 3 The Computer Even a Baby Can Use by Kenneth Perry et al.
- 4 The Qube by Roger Garrett
- 5 Octal Debugging Program ODT—80 by E. R. Fisher
- 6 Graphics—The Easy Way
 - 7 Z-80 MITS 12K Extended Basic Patches

THE DECEMBER WINNER OF THE \$100 PRIZE FOR THE BEST ARTICLE OF THE MONTH WAS ROGER RAWSKOUB'S "DR. WANG'S PALO ALTO TINY BASIC.

NEXT MONTH ANNOUNCEMENT OF JANUARY'S BEST AUTHOR WINNER.

March 1977 Issue Void after May 30, 1977 (Please type or print) Name _ Title. Title. Phone (A/C) _ Phone (A/C)_ Company Company Address . ☐ Home ☐ Business Address _ State_ Country___ State. Country_ ANSWER THE FOLLOWING BY CHECKING ANSWER THE FOLLOWING BY CHECKING 5. My Application is A. Hobby Only B. Business Only 5. My Application Is A. Hobby Only B. Business Only C. Hobby & Business ONE BOX ONLY PER QUESTION. ONE BOX ONLY PER QUESTION. 1. I Am A A. □ Professional (Medical, Accounting, Law, Etc.) B. □ Engineer (Electronics, Mechanical Etc.) C. □ Business Person (Retail, Wholesale, Etc.) D. □ Educator (Professor, Teacher, Assistant, Etc.) E. □ Student F. □ Hobbyist G. □ Other C. D Hobby & Business 1. I Am A A. D Professional (Medical, Accounting, Law, Etc.) B. D Engineer (Electronics, Mechanical Etc.) C. D Business Person (Retail, Wholesale, Etc.) D. Educator (Professor, Teacher, Assistant, Etc.) E. D Student F. D Hobbyist G. D Other D. ☐ Instruction Purposes E. ☐ Research D. Instruction Purposes E. D Research F. Design & Development G. Other F. Design & Development G. Dother S. D'uren S. My Primary Source Of "State-of-the-Art" Information Comes From: A. A. B. Agazines B. D Exhibits & Conventions C. Club Meetings D. D Direct Mail From Manufacturers. E. Other Other 6. My Primary Source Of "State-of-the-Art" Information Comes From: A. □ Magazines B. □ Exhibits & Conventions C. □ Club Meetings D. □ Direct Mail From Manufacturers. E. □ Other ______ 2. My Status Is A. A. Area All Computing Equipment B. D. Need More Peripherals C. Have CPU Only 2. My Status Is A. □ Have All Computing Equipment B. □ Need More Peripherals C. □ Have CPU Only C. ☐ Have CPU Only D. ☐ Have No Equipment A. Directly From Manufacturers B. Local Computer Retailer (Store) C. Mail Order D. Club Group Purchases E. Other E. Unter 7. I prefer To Buy A. Directly From Manufacturers B. Local Computer Retailer (Store) C. Mail Order D. Club Group Purchases E. Cother ☐ Have No Equipment E. □ Other F D Other 3. I Need This Information For 3. I Need This Information For A. ☐ Immediate Purchase B. ☐ Purchase 30-60 Days A. Immediate Purchase B. Purchase 30-60 Days D. Literature Library 8. I Look To INTERFACE AGE First For D. Literature Library 8. I Look To INTERFACE AGE First For F Other E. Other A. ☐ New Product Information B. ☐ Software Information A. ☐ New Product Information B. ☐ Software Information 4. My Interest Emphasis Is 4. My Interest Emphasis is A. ☐ Hardware B. ☐ Firmware C. ☐ Tutorials D. ☐ Hardware Articles A. ☐ Hardware C. D Tutorials D. D Hardware Articles C. Softwar C. Softwar E. □ Product Advertising F. □ Remarks _____ E. □ Product Advertising Please send information on items circled below. Please send information on items circled below.

9 10 13

14 15 16 17 18 19 20 21 22 23 24 25 39 40 41 42 43 44 45 46 47 48 49 50 64 65 66 67 68 69 70 71 72 73 74 75 99 90 91 92 93 94 95 96 97 98 99 100 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400

READER SERVICE CARD

Please use only 1 card per person. Thanks!

9 10 11 26 51 76 5 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 177 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 69 79 88 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 43 44 45 46 47 48 49 50 68 69 70 71 72 73 74 75 93 94 95 96 97 98 99 100 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 146 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 266 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400

READER SERVICE CARD

March 1977 Issue

Void after May 30, 1977 (Please type or print)

☐ Business

☐ Home

Please use only 1 card per person. Thanks!

READER SERVICE CAP



UBSCRIPTIO

We've got something for every baud!

SUBSCRIPTION APPLICATION FORM PAYMENT MUST ACCOMPANY FORM

SUBSCRIPTION FEE per year: \$10.00 U.S., \$12.00 Canada/Mexico, \$18.00 Foreign.

Make check payable to:

INTERFACE Magazine

P.O. Box 1234, Cerritos, CA 90701

Name		Title		
Company				
Home Address				
City	State	Country	Zip	
Date	Signature			
СНЕСК	MONEY ORDER	BANKAMERICARD scolerms have	master charge	

Account # _ Expires

PLANNING TO MOVE?

Let us know 8 weeks in advance so that you won't miss a single issue of/INTERFACE.

Attach old label where indicated and print new address in space provided. Also include your mailing label whenever you write concerning your subscription. It helps us serve you promptly.

If you have no label handy, print OLD address here.

Please Print		
Name		
Company		
Address		
City	State	Zip code
Affix Label	Print NEW address here	
Name		
Company		
Address		
City	State	Zip code

MAIL COMPLETED CARD TO:

JUICHTALE Magazine

P.O. Box 1234 Cerritos, California 90701



First Class Permit No. 217 Clinton, Iowa

BUSINESS REPLY MAIL

	Postage will be paid by	No Postage Stamp
7)] 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	ьу	No Postage Stamp Necessary if Mailed in the United States
		States

Box 2654 Magazine

Clinton, Iowa 52732

First Class Permit No. 217 Clinton, Iowa

BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

Postage will be paid by



Box 2654

Clinton, Iowa 52732

Experience the excitement of owning the world's finest personal computer – IMSAI 8080

Waiting for you — all the incredible performance and power of the IMSAI 8080. And at a price you would normally pay for a fine home music system.

Introduced less than two years ago, the IMSAI 8080 is sold world-wide and acknowledged as the finest *personal* computer available.

WORLD OF USES

The IMSAI 8080 is a superbly engineered, quality computer. It is versatile, expandable and powerful, putting literally hundreds of

applications and uses at your fingertips. Imagine sitting at your desk and enjoying interaction with your IMSAI 8080! Press the on switch and you're ready for game playing, research, education, business applications, or for laboratory instrument control. It has all the power you need, and more, to make your application ideas come alive.

GROWS WITH YOU

The IMSAI 8080 is designed for many years of pleasure. With its open-chassis engineering you can expand your system by adding peripherals and interfaces. The 22-slots and 28 amp power supply mean that you can plug-in today's, plus tomorrow's modules.

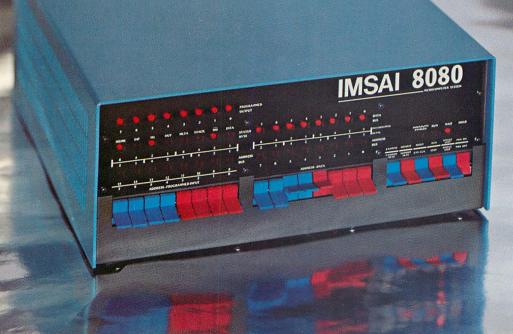
Right now you can add a module for displaying color graphics and characters on TV; a ready-to-use keyboard; small and large printers, and a single interface that lets you attach multiple devices including a cassette tape recorder. Expect the latest, exciting equipment from IMSAI. We are committed to leadership in this expanding technology.

EASY TO PROGRAM

With our BASIC language you can operate the IMSAI 8080 quickly and easily. Technically knowledgeable? Use our assembly language to develop sophisticated and unique software.

If you're thinking personal computer, treat yourself to the very best — IMSAI 8080

Send for free four-color brochure or \$1 for catalog. Call or write for name of nearest dealer.



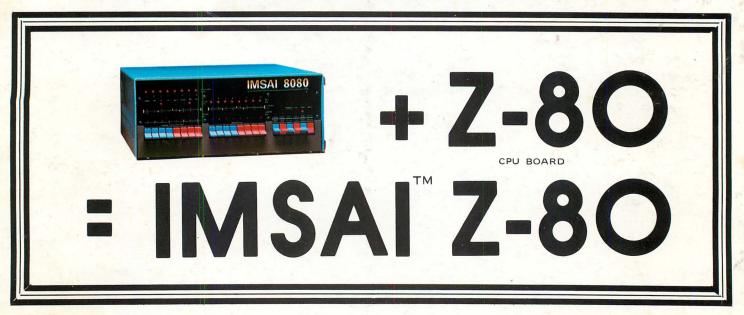
IMSAI

IMSAI Manufacturing Corporation 14860 Wicks Blvd. San Leandro, CA 94577 (415) 483-2093 TWX 910-366 7287

ULTRABYTE



THE FORMULA FOR POWER



THAT'S RIGHT! THIS ULTRA-POWERFUL COMBINATION IS OFFERED BY ULTRABYTE,
YOUR FACTORY AUTHORIZED DEALER OF ALL THESE QUALITY COMPONENTS

PLEASE RUSH ME THE FOLLOWING: *IMSAI Z-80 Standard Kit, (without Standard CPU Board) with Powerful TDL ZPU Board Same as above (IMSAI plus Z-80), but with 22 Slot Mother Board Card Guides, 20 pairs\$ 20.00 IMSAI Multiple I/O Board, Kit . . . TDL 4K Expandable Memory, Kit (IMSAI/ALTAIR Compatible) \$ 159.00 TDL 16K Memory TDL 4K Expansion Kit TDL ZPU Card (gives you access to TDL Software) SFALS 8K Board 500 ns Maximum ICOM's Microfloppy Disk System, Including Drive, Power Supply, Cabinet, Controller/Interface Card, Manuals, Diskette & Software ICOM's Frugal Floppy, including Disk Drive, CF 360 Controller, all Cables and Connectors . ICOM's Frugal Floppy, same as above, but with Dual Disk Drive PHONE (714) 892-4679 PRICES SUBJECT TO CHANGE WITHOUT NOTICE

*PHONE IN YOUR CREDIT CARD ORDERS *CALIF. RES. ADD 6% SALES TAX *MOST ORDERS SHIPPED WITHIN 30 DAYS *SHIPPING CHARGE: COLLECT F.O.B. FACTORY
Enclosed Check or Money Order
For \$
Bankamericard No
Mastercharge No
Interbank No
Signature:
Name:
Address:
City, State, Zip:
UltraByte Incorporated
SEND MAIL TO:
P.O. Box 370, Westminster, CA. 92683 (714) 892-4679
Executive Offices:
Park Plaza Building, Suite 8
7281 Plaza Street, Westminister, CA. 92683
(Send Self-addressed, stamped envelope for complete computer accessory list)